

40 W.O.

HANDBOOK

OF THE

Q.F. 18-PR. GUNS,

MARKS I, I*, II AND II*,

ON

CARRIAGES, FIELD,

MARKS I*, I** AND II.

LAND SERVICE.

1922.

By Command of the Army Council,

THE WAR OFFICE, January, 1922.



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N.B.—This book is corrected up to September, 1921. Any alterations which may be suggested should be forwarded direct to the Chief Inspector, Royal Arsenal, Woolwich.

PART I.

INTRODUCTION.

The Mark I Q.F. 18-pr. equipment was introduced into the Service in June, 1904, and was designed to embody the experiences of the South African War.

The design embodied many new features, prominent amongst which the following may be cited:—

Single loading.
Long recoil.
Independent line of sight.
Top traverse.

In addition the carriage and ammunition wagon, together with their limbers, are provided with shield protection for the detachment in action. These features, coupled with improvements in design and developments in materials, allowed of the provision of a more powerful equipment than had hitherto been possible within the limits of weight

usually considered satisfactory for Field Artillery.

Single loading is obtained by means of a fixed Q.F. cartridge, comprising means of ignition, propelling charge, projectile and fuze in one unit, thus ensuring smooth and rapid loading. The long recoil buffer gives reduced firing stresses on the carriage and increases its steadiness in action. The independent line of sight and the top traverse enable the layer to carry on his duties without hindrance by the loading or ranging functions. This results in greater accuracy and rapidity in the service of the gun. The shield is of great value as it affords the detachment a sense of security, which, combined with the above-mentioned new factors, has resulted in the provision of what has proved to be a highly satisfactory equipment.

A further point of interest is the provision of seating accommodation on the trail for the laying and breech numbers, an advantage rendered possible by the steadiness of the carriage during recoil.

The limbers and ammunition wagon were improved with the object of facilitating the ammunition supply in action. The ammunition is carried practically ready for loading, only needing the removal of safety clips and setting of time fuzes. The latter are of the tension type, and do not require unclamping before setting, or clamping after setting. When ammunition is in the limbers and wagon, only the base of the case of the cartridge is visible; consequently it has been found necessary to have identification marks on the base of the cartridge, in addition to those on the shell, to avoid confusion and delay when several natures of projectile are carried in the same vehicle.

Originally, the only projectiles provided were shrapnel, with a small number of star shell for special purposes; at present, however, shrapnel, high explosive, gas and smoke are all provided. Incendiary ammunition has also been in use until recently.

On the whole, the equipment may claim the following advantages over field equipments of earlier designs:—

Heavier and more powerful projectile. Increased rate and accuracy of fire. Better protection for gun detachment.

Commencing in 1916 a number of Q.F. 18-pr. Mark I Carriages were modified by being fitted with a new type of hydraulic buffer and hydro-pneumatic recuperator. The carriages so modified are designated Mark I* or I** and carriages manufactured to the new design, Mark II.

The buffer and recuperator are contained in a steel cylinder block which fits inside the cradle and is free to recoil with the gun; the piston rods of the buffer and recuperator, being nutted to the cradle

cap, remain stationary.

The buffer is of the rotating valve type, and an oil reservoir is

provided above the buffer.

The hydro-pneumatic recuperator possesses the following chief advantages over a spring recuperator:—

(i) The speed of run-out can be regulated.

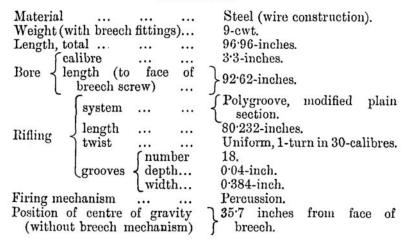
(ii) The troubles due to springs breaking or taking a permanent set are obviated.

PART II.

ORDNANCE.

Q.F. 18-PR., MARKS I, I*, II AND II* GUNS.

PARTICULARS.



GUN BODY, MARK I.

(Plate I.)

The gun is made of steel and consists of the "A" tube, a series of layers of steel wire, jacket and breech ring. The "A" tube extends from the rear end of the chamber to the muzzle. Over the rear portion of the "A" tube are wound successive layers of steel wire. The jacket is fitted over the exterior of the wire and "A" tube and is secured longitudinally by corresponding shoulders and the breech ring, which is screwed over the jacket at the rear and secured by a set screw. The breech ring is prepared for the reception of the breech mechanism and is provided on the upper side with a lug for the attachment of the hydraulic buffer. Longitudinal projections on each side of the jacket form guides for the gun when in the cradle of the carriage.

The chamber is slightly coned throughout its length, to facilitate

the extraction of the cartridge.

A plane for clinometer is prepared on the upper surface of the

breech ring.

An axis line is cut on the right side of the breech ring. Vertical and horizontal lines are also cut on the muzzle face and horizontal lines on the breech face.

The guns are marked on the top and right side with black and red lines on white ground for indicating excessive recoil. The black and red lines are each 0.5-inch wide, the red being nearest the muzzle and 47 inches from the front of breech ring.

GUN BODY, MARK I*.

Mark I* guns are Mark I guns repaired by the renewal of the "A" tube.

The repair consists in fitting into the old jacket, under hydraulic pressure, a new "A" tube with new winding wire. The exterior of the "A" tube with its wire is slightly tapered and the interior of the jacket is bored to correspond.

GUN BODY, MARK II.

(Plate I.)

Mark II guns differ from Mark I as follows:-

The exterior of the "A" tube is slightly conical, the interior of the jacket being coned in a corresponding manner to admit of the guns being built up by means of hydraulic pressure instead of by shrinkage.

NOTE.—A certain number of *Mark II* guns have been fitted with a "catch, retaining cartridge" for use against aircraft. These guns are now obsolete so far as anti-aircraft requirements are concerned and have been converted for use on field carriages by having the

cartridge retaining catch plunger and spring removed, and the outer end of the hole for catch in the breech ring filled by the cartridge retaining catch plug. The plug is secured from turning when in position by having the metal of the breech ring riveted into chisel nicks and the outer end is rounded to the contour of the breech ring.

These guns are distinguished by having a star (*) added to the

Mark and are described as Mark II*.

BREECH MECHANISM.

(Plate II.)

The guns are fitted with "Single Motion Breech Mechanism." The mechanism is so arranged that by one pull on a lever the breech is unlocked and the screw and carrier are swung into the loading position. After loading, one thrust on the same lever inserts the breech screw into the breech opening and turns it into the locked position.

BREECH CLOSING MECHANISM.

The breech is closed by a steel screw tapering towards the rear (Maelstrom type). Segments of the screw thread are removed from opposite sides of the screw; the breech opening of the gun being prepared in a corresponding manner, admits of the screw being locked in the gun by the fourth of a turn.

The screw is provided on the rear end with left-hand screw threads which engage with corresponding screw threads in the inner

face of the carrier.

The carrier for supporting the breech screw when withdrawn from the gun, consists of a steel arm hinged to the right side of the gun at the breech. It is prepared on the inner face for the reception of the breech screw and on the outer face with a recess for the striker guide block and two lugs for the hinge bolt of the breech mechanism lever. A steel catch with spiral spring is fitted to the interior of the carrier and serves to retain the breech screw in the open position. The catch is automatically released in closing the breech.

In order to prevent damage to the breech mechanism, in the event of a failure of cartridge case, a gas escape hole and channels are formed in the carrier.

Hinged to the rear face of the carrier is a breech mechanism lever, provided with bevel teeth which engage with corresponding teeth on the rear face of the breech screw, so arranged that when the lever is pulled to the right, the first movement of the lever unlocks the breech screw and on continuing the motion, the screw and carrier are swung into the loading position.

The breech mechanism lever is retained in the closed position by means of a catch (with flat spring in the case of Mark I lever or spiral spring in the case of Mark II lever) pivoted in the lever, one end of which engages a recess in the lower lug on the rear face

of the carrier.

FIRING MECHANISM.

(Plate III.)

The firing mechanism is for percussion firing and is so arranged that the gun cannot be fired before the breech screw is locked and the breech mechanism lever home.

It consists of a striker with firing pin, rebound block and securing pin, main spring, guide for spring and tripping piece with flat spring and fixing screw, fitted through the centre of the breech screw and retained in position by the striker guide block on the carrier. A steel firing lever in the interior of the striker guide block serves to cock the striker and fire the gun, one end of the lever engaging with the tripping piece and guide for spring, the other end with the trigger in the left side of the gun when the breech is closed.

The trigger is actuated by a direct pull on the firing gear of the carriage, thus partially revolving the firing lever, by means of which the striker is forced to the rear and the guide for spring to the front; the main spring is thus compressed until the projecting toe on the inner end of the firing lever slips past the front end of the tripping piece in the striker guide block, when the striker is free to go forward with momentum due to the energy stored up in the compressed main spring and detonates the percussion primer of the cartridge.

The firing lever is returned to the firing position by means of the

guide for spring.

The front end of the firing pin in the striker is withdrawn within the firing hole bush by means of a rebound block in the striker, which engages a recess in the breech screw for its reception.

A loop is provided on the lower part of the trigger for the attach-

ment of a firing lanyard if required.

A safety catch, with flat spring, is fitted to the striker guide block for retaining the striker in the uncocked position, thus admitting of

the gun being travelled with a cartridge in the bore.

NOTE.—The hook of the firing lanyard is of special pattern and must be attached to the loop on the trigger as shown on Plate XXIII. Should a jam occur after firing, care must be taken to see that the striker is flush with the rear end of the striker guide block before force is used to open the breech. In cases where the striker is not flush with the guide block, withdraw the keep pin and hinge bolt of the breech mechanism lever and remove the lever, guide block, firing lever and striker from the gun. Replace the breech mechanism lever and hinge bolt and swing the breech screw and carrier into the loading position. Replace the striker, firing lever and guide block.

EXTRACTOR.

The extractor is of steel and is hinged to the right side of the gun. On the inner end are two arms which clip the rim of the cartridge, the outer end forming a lug, by means of which the extractor is automatically actuated in opening the breech.

INSTRUCTIONS FOR REMOVING AND REPLACING BREECH FITTINGS.

TO REMOVE THE BREECH FITTINGS.

Before commencing to remove the fittings, the breech screw and

carrier should be swung into the loading position.

Breech mechanism lever, guide block, firing lever, striker and firing pin.—Remove the keep pin of the breech mechanism lever hinge bolt and withdraw the hinge bolt, when the breech mechanism lever, guide block with firing lever and striker can be removed. Slide the firing pin out of the striker.

Breech screw and retaining catch.—Press in the catch retaining breech screw clear of the recess in the screw and unscrew the latter (to the right) from the carrier. Withdraw the retaining catch with

spiral spring.

Firing hole bushes, Marks I and II. (This will only be carried out by an armament artificer.)—Unscrew the bush from the interior of the breech screw by means of the special wrench. In the case of Mark II bushes, care must be taken to first remove the fixing screw for the bush in the breech screw.

Carrier.—Remove the keep pin of the carrier hinge bolt and withdraw the hinge bolt and carrier.

Extractor.—Remove the keep pin of the extractor hinge bolt

and withdraw the hinge bolt and extractor.

Trigger.—Remove the keep pin and withdraw "Part I" trigger with bush, collar and spring from the left side and "Part II" trigger to the rear.

Striker and guide block.—When removing the striker from, or inserting it into, the guide block, the safety catch in the latter must always be in the firing position.

Striker, main spring, &c.—Press on the top of the spring guide so as to slightly compress the main spring and at the same time tilt the upper end of the guide from the striker and withdraw the guide and main spring. Slide the firing pin out of the groove in the front end of the striker. Remove the pin securing rebound block and withdraw the latter.

Safety catch, guide block.—Place the safety catch in the firing position and force it out of its recess in the guide block towards the centre of the block and withdraw it.

TO REPLACE THE BREECH FITTINGS.

The fittings are replaced in the reverse order.

When inserting the breech screw in the carrier, care must be taken, before commencing to screw in, to hold the breech screw "square" against the face of the carrier with one of the threaded portions of the screw uppermost, the stamping on the screw being to the rear. Two and one-quarter turns of the breech screw are required in screwing in, the retaining catch being pressed in clear of the recess in the screw during this operation.

When inserting the trigger, first correctly assemble the spring with the projecting ends in the holes for their reception in the "Part I" trigger and bush, then insert the collar on the trigger with the recessed portion innermost and twist the bush on the trigger until the projection on it engages with the recess in the collar. Insert "Part I" trigger with bush, collar and spring into the left side of the gun and engage with "Part II" trigger inserted from the rear. Insert keep pin.

To Gauge Protrusion of Firing Pins.

The protrusion of firing pins of strikers is gauged by the "Gauge, striker protrusion, No. 1." The instructions for use of gauge are as follows:—

Swing the breech screw and carrier into the loading position and remove the striker. Take out the main spring from the striker and re-assemble the latter. Replace the striker (without main spring) in position in the breech mechanism, press in the "Catch, retaining breech screw" and revolve the breech screw in the carrier until it is in the position it would be for firing if the breech were closed.

Press the striker forward in the breech screw as far as it will go

and apply the gauge to the front face of the breech screw.

If the protrusion of the firing pin is not between the limits of 0.09-inch to 0.11-inch, as shown by the gauge, the firing pin will be exchanged.

PART III.

CARRIAGES, SIGHTING, LIMBERS AND AMMUNITION WAGONS, &c.

CARRIAGE, FIELD, Q.F. 18-PR., MARK II. (Plates IV to VII.)

The carriage is constructed to allow of 16-degrees elevation and 5-degrees depression being given to the gun, which recoils axially in a cradle, the latter being fitted with a hydraulic buffer to limit the recoil to about 45-inches under normal conditions and an hydropneumatic air recuperator to return the gun to the firing position. The carriage is arranged so that the gun can be elevated or depressed, with or without a corresponding movement of the sight gear, or to be traversed, within certain limits, without moving the trail. It is provided with a seat on each side of the trail for two of the gun detachment and with a shield for the protection of the numbers serving the gun.

The carriage is fitted to carry various stores (see list of stores, page 34, and packing diagram, page 39).

The principal parts of the carriage are:-

Trail.
Carriage body.
Cradle.
Hydraulic buffer.
Hydro-pneumatic recuperator.
Elevating gear.

Range gear.
Traversing gear.
Firing gear.
Brake gear.
Shield.
Axletree and wheels.
Sights.

TRAIL.

The trail is tubular and is secured to the axletree by a bracket, which also forms a pivot for the carriage body. The rear end is fitted with a spade, lifting handles, trail eye and a traversing lever, the latter folded down and held by a spring clip when not in use. Near its lower end is shrunk on a locking band; about its centre is a band for the attachment of the brake arms and rearends of tensile stays and in front of this again is a bracket with a dovetailed projection on which the rear-end of the carriage body slides for purposes of traverse. A handhole and a cover is provided on the upper side for the attachment of the traversing lever bracket on repair

A cast-steel saddle, to take the air pump for the recuperator, is formed in two portions and bolted to the trail in front of the locking

band

To prevent the saddle being misplaced a hole is provided on the underside of the trail and a locating peg is riveted inside the lower portion of the saddle. On each side of the lower portion a hole is provided for a spring trunnion pin on which the forked lever operating the pump works.

A breech-type fastening is provided on the top portion into which

the pump for the recuperator fits when in use.

CARRIAGE BODY.

The body consists principally of two triangular-shaped brackets connected by transoms and provided with bearings on the underside at the front, through which the axletree passes and by which it is pivoted for traversing. To the underside at the rear is fitted a bracket in which is formed a groove to fit over the traversing bracket on the trail. Bearings are fitted on the top front to receive the eradle trunnions which are held in position by capsquares.

An arc, which is used in conjunction with a clamp on the trail and body to lock the body to the trail in travelling, is fitted on the

right side; it allows of adjustment of the clamp as required.

CRADLE.

The cradle is of bronze, with steel trunnions to pivot it to the carriage body, the left trunnion being prolonged and threaded for the reception of a stud for supporting the rocking-bar sight; it has an opening in the lower portion for the gun and in the upper portion for a steel casing which contains a steel cylinder block in which are formed the hydraulic buffer and recuperator cylinders. Longitudinal recesses are cut in the inner surface of the lower portion for the reception of the guides on the jacket of the gun. A steel guard is fitted to the left side to protect the gunlayer and a notch and point are formed above the steel case for rough laying.

CRADLE CLAMPING GEAR. . (Plates VIII and IX.)

The gear is provided to clamp the cradle to the carriage body in the travelling position. A spindle with clutches and handle is fixed to the carriage body, so that when the gun is fully elevated the clutches may be made to engage with semicircular-shaped lugs formed on the underside of the cradle and rigidly fix the cradle to the carriage. Two stops, one of which is adjustable, are fitted to the carriage body to limit the travel of the handle of the clutch spindle. This gear also determines the point of maximum elevation. In the event of the clamping gear becoming jammed and difficult to release, it can be overcome by easing the *lower* elevating wheel by hand before unclamping.

HYDRAULIC BUFFER AND RECUPERATOR.

(Plate X.)

The hydraulic buffer and recuperator cylinders are formed in a steel cylinder block which fits on the guides inside a steel easing screwed into the cradle collars. The rear-end of the block extends beyond the easing and is screwed to receive an adapter by which the block is nutted up to the lug of the gun.

The front-end of the casing is closed by a M.B. cap, which is prepared for the attachment of the piston rods of buffer and recuperator; thus, on recoil, the buffer and recuperator cylinders are drawn back through the easing from off the piston rods which are held fast by the cap of the casing. Four openings are bored in the block, viz.: buffer, oil reservoir, recuperator liquid cylinder and H.P. cylinder.

The case and adapter are prepared to give access to all filling and adjusting devices without disconnecting the gear.

HYDRAULIC BUFFER.

(Plate A.)

The buffer cylinder has two spiral grooves cut in its interior surface to rotate the recoil valve during the recoil of the gun. The front-end is closed by a steel washer, vulcanised fibre washer, a M.B. neck ring, and L-shaped packing ring of special composition, the whole being held in position by a steel stuffing-box screwed into the buffer and prevented from unscrewing by a locking plate.

Into the stuffing-box is placed a ring of "Turners" compressed packing and a M.B. gland ring, which are held in position by a M.B. gland screwed into the stuffing-box. A number of slots are cut around the flange of the gland into either one of which engages a spring catch to prevent it unscrewing. Tommy holes in the front cap and gland enables the latter to be tightened without removing the cap.

The rear-end is closed by a steel plug prepared on its inner-end to form a control chamber. The front-end of the chamber is bushed with M.B. where the plunger enters, while near its rear-end an oblique hole places the chamber into communication with the buffer cylinder. Screwed into the centre of the closing plug in front of the oblique hole is a steel "plug, adjusting run out" with coned point

which regulates the flow of liquid from the control chamber to buffer through the oblique hole. Flats on the front of steel plug allow liquid to pass from rear to front during run out. The rear-end of the closing plug is bored out in different diameters to contain packing, through which the stem of the adjusting plug passes to the outside. The packing consists of a ring of asbestos enclosed between two M.B. neck rings, which are held in position by a M.B. gland screwed into the closing plug and held by a lock nut. The gland is hollowed to form a scating for one end of a spiral spring, the other end of which bears against a M.B. cap fitting over the rear-end of the adjusting plug. On the front of the cap are a number of serrations which engage similar serrations in the steel plug and so locks the adjusting plug. A steel locking-plate prevents the cap disengaging from the steel plug.

Working in the cylinder is a steel piston rod, the front-end of which passes through the packing and is secured to the cap of the case by a collar inside and a nut outside the cap.

To the rod near its rear-end is screwed and riveted a M.B. piston, which has two ports for the passage of liquid from one side to the other on recoil and run-up.

The control plunger, which is in one with the piston rod, projects behind the piston and works in the chamber formed on the rear closing plug. It tapers slightly towards its rear-end and has a flat filed on it in the direction of its length. The base of the plunger is prepared to receive the recoil valve and its fittings.

The recoil valve is of M.B. and fits loosely over the control plunger around which it is free to revolve. It has two shaped ports for the passage of liquid and externally has two studs or feathers to work in the spiral grooves of the buffer. The valve is held against the rear face of the piston by a steel washer. The washer is feathered to the control plunger and in turn is held by a nut screwed and pinned to the plunger.

An air hole bored through the buffer at the front end is closed by a screw plug with leather washer. This plug is marked "N."

The oil reservoir is bored in the block above the buffer cylinder with which it is in constant communication by a small hole at the bottom of the reservoir near its rear end. Fitted to the rear-end of the reservoir is a small relief valve, access to which can be gained by a hole in the case. The object of the valve is to enable the air in the reservoir to be released should the gun not run fully into the firing position.

Screwed into the front-end of the reservoir is a steel tube which passes through to the front of the cap and has a filling hole closed by a screw plug and leather washer. This plug is lettered "O."

For filling buffer, see page 41.

Gear regulating recoil.—This gear is intended to be used to shorten the recoil when the latter becomes excessive through wear in the piston, recoil valve, &c.

Feathered to the front end of the piston rod and held on by the piston rod nut is a steel actuating lever which has a number of serrations at its upper end to engage similar serrations formed in a stop secured to the top of the cap.

The stop has a scale scribed on it, each figure representing 1-in. alteration in recoil, which is read by a line engraved on the lever. An arrow to show direction of turning for shortening the recoil is engraved on the scale.

When the indicating line on the lever is reading zero on the scale the piston is set to give a recoil of 45-in., and, should this be exceeded, the nut and pin securing the stop is removed, the stop drawn out to clear the lever, the lever revolved in the direction of the arrow till the mark is opposite the graduation required, and the stop replaced.

In revolving the lever, the piston rod and piston are revolved with relation to the recoil valve, thereby decreasing the flow space through the ports in the latter, which increases the resistance set up in the buffer during recoil, thus shortening the length of recoil.

RECUPERATOR.

(Plate X.)

The recuperator is on the hydro-pneumatic principle and consists of a liquid cylinder in which works a piston rod with packed piston and a hydro-pneumatic cylinder which contains liquid and air at an initial pressure of 700-lbs. per square inch.

The liquid cylinder is closed at its front end with packing and gland similar to that described for the buffer, except that the steel washer is omitted. Near the front inside end of the cylinder is a shoulder which forms a seating for a retarding valve.

The valve is of M.B. and fits loosely around the piston rod, being kept pressed tightly against its seating by a spiral spring, one end of which bears against the head of the valve and the other against the neck ring of the packing.

Four holes are bored through the head of the valve, through which the liquid escapes from the H.P. cylinder to the liquid cylinder on run-up. In front of the valve an opening is bored through the liquid cylinder, which places the two cylinders into communication with one another through a pipe fixed in the bottom of the H.P. cylinder.

The Mark I piston rod is of steel screw-threaded at each end. The front end passes through the packing and is secured to the front cap by a screwed collar inside and a nut and pin outside the cap. In addition, a wire with lead seal is attached to the front-end of the piston rod which prevents it being detached from the cap. This is done so that the recoil system shall not be tampered with. Screwed and riveted to the rear-end of the rod is a M.B. piston, which has three small holes bored through it to allow the liquid to penetrate to the piston packing. The piston packing, which is supported on a spindle screwed and pinned to the rod, consists of a M.B. supporting ring, U-shaped ring of special composition, second supporting ring and U-shaped packing ring held between the rear face of the piston and a shoulder on the spindle; behind the shoulder around the spindle are fitted four coils of "Lion" patent packing, M.B. supporting ring and spiral spring

^{† &}quot;Dick's" patent packing may be used as an alternative.

secured in position by a nut screwed and pinned to the spindle. Air

grooves are cut around the piston and supporting rings.

The Mark II piston rods differ from the Mark I in having the "Lion" or "Dick's" packing shaped to suit a new pattern M.B. supporting ring and adjusting sleeve and in the omission of the U-shaped packing rings, U packing supporting rings, piston packing supporting ring and piston spring.

The Mark I piston rod converted approximately to the Mark II

will be known as Mark I*.

The H.P. cylinder has its front end closed by a plug screwed in; internally the plug is screwed to receive a tapered steel pipe which places the cylinder into communication with the liquid cylinder in front of the retarding valve; the pipe length is designed to ensure that its inner end is below the liquid level of the H.P. cylinder at the maximum elevation provided the system is properly charged. The rear-end of the cylinder is closed by a screw plug. Three openings are bored in the cylinder block at the rear-end communicating with the H.P. cylinder, viz., one on the left for oil filling, one on the right to take the adapter for air filling, and one at the rear in which is fitted a stop valve, which, when screwed home closes the passage leading from the adapter hole to the cylinder. The oil filling and adapter holes are closed by screw plugs and leather washers, the plugs being lettered "K" and "L" respectively, while the stop valve is lettered "M." An opening is bored through the breech lug adapter to give access to the stop valve, the letter "M" being engraved on the adapter near this hole.

For charging with oil and air, see pages 41 to 44.

Action of buffer and recuperator.—On firing, the gun recoils through the cradle taking with it the buffer and recuperator cylinders, the piston rods remaining stationary. As the buffer cylinder is drawn back the oil passes through the ports in the piston and recoil valve from front to rear.

At the commencement of recoil the ports in the piston are uncovered by the recoil valve, but as the recoil proceeds the valve is caused to rotate on the piston rod by the grooves in the cylinder, thus causing the ports to be gradually closed, so graduating the pressure in the cylinder during recoil. During recoil the control chamber is drawn off the control plunger.

As the recuperator cylinder is drawn back the oil is swept by the stationary piston rod into the H.P. cylinder, the retarding valve being forced off its seating for this purpose. The liquid entering into the H.P. cylinder raises the air pressure in the system, thus assisting somewhat to absorb the recoil. On recoil ceasing the retarding valve closes, the air expands and forces the liquid back through the holes in the valve into the recuperator cylinder, thus returning the gun into the firing position.

The gun is prevented from running up with violence by the throttling effect of the retarding valve and also by the control plunger, which latter, as the gun nears the firing position, enters its chamber and displaces the oil therein, at first over the tapering flat on the plunger and also past the adjusting plug through the

oblique hole, but finally through the latter means only.

The working recoil is 45-inches. Metal to metal 49.5-inches.

ELEVATING AND RANGE GFAR.

(Plate VIII.)

The elevating gear is divided into two portions, upper and lower, by the employment of a double-ended elevating screw to the

centre of which an arm carrying the sights is attached.

The gears are so arranged that the elevation of the gun can be altered without altering the line of sight. The handwheel on the left of the carriage is for aligning the sight on the target (the range indicator remaining stationary), while the handwheel on the right side is actuated until the required range is indicated on the yard scale ring (the sight remaining stationary).

The Mark III range gear indicator consists of a spring case with woodite washers, stud, clock-type spring, spring barrel, jamming plate, yard scale ring, pointer degree scale with two screws, M.V. scale plate, plate carrying M.V. scale, two readers (one for yard scale and

one for M.V. scale), carrier M.V. pointer and reader.

It is fitted to the right side close to the handwheel, the yard scale ring being graduated on its face in hundreds of yards to 6,600-yards with readings by means of a pointer for every 25-yards; the periphery of the ring is graduated up to 16-degrees with readings for every 10-minutes; the yard and degree scale is prevented from slipping by two woodite washers; the washer on the inside bears between the ring and the spring case and that on the outside between the ring and the jamming plate. The gear is supported on a cross spindle which is held in bearings in the cradle. The inner end of the spindle carries a pinion which works in the arc supported from the centre of the elevating screw. The spring case contains a clock spring which eliminates backlash between arc and pinion.

A M.V. carrier is secured to the handwheel spindle pinion bearing, the M.V. scale carrying plate with a graduated M.V. scale being

attached to the carrier and the indicator pinion.

A catch and plate is fitted to clamp the range gear.

A bracket for No. 7 dial sight, with carrier and deflection scale, is secured by screws to the arc of the range gear. A clamping screw is provided for securing the carrier in the bracket.

On coming into action (gun being in the housed position) release the clamping handles of the cradle and carriage body clamping gears, place the traversing pointer at 0-degree and bring the gun to about the horizontal position by means of the left elevating handwheel. Either gear, elevating or range, can then be worked as required.

TRAVERSING GEAR.

(Plate I.Y.)

The traversing gear consists principally of a crosshead, link nut and an actuating screw with a handwheel. The crosshead is pivoted vertically to the traversing bracket on which the rear end of the carriage body slides. The working parts are protected from the ingress of dust, &c., by cotton packing, packed round the outside of the link nut. The nut is linked to the carriage body and by means of the handwheel on the end of the screw, 4-degrees of traverse right or left can be obtained. A scale strip and pointer indicate the angle of traverse. The scale strip has black graduations on brass on the left and white graduations on a black ground on the right side of zero. A leather loop, fixed to the cap of the lower elevating gear bracket, is slipped over the handle of the hand-wheel to prevent the latter turning when travelling.

FIRING GEAR.

The firing gear is arranged so that the layer can fire the gun without altering his position when laying. It is attached to the left side of the cradle and consists principally of a connecting rod, connecting arm and a spring lever, which engages with the trigger of the gun. The connecting arm is pivoted to a fulcrum on the cradle at one end; the other end is connected to a spring lever by the connecting rod, which is provided with a handle for operating the gear. After firing, the handle is returned to the forward position by a spring attached to the lever and the guard protecting gun layer.

The gun can be fired when within 2-inches of the "run-up"

position.

BRAKE GEAR.

(Plate XI.)

The tire brake is for use when travelling and is always to be used when firing. It consists principally of two brake arms, two cranked levers, connecting rods and an actuating screw. The brake arms are pivoted at one end to a bracket on the trail and provided at the other end with the service cast-iron brake block, which acts on the wheels. Each of the cranked levers is pivoted to brackets on the axletree. one on each side of the carriage body; one arm of each lever is connected in front of the axletree by a connecting rod; the outer arm of the right-hand lever is provided with a nut, through which the front end of the actuating screw passes, the other end of the screw being linked to the right brake arm. The outer arm of the left-hand lever is connected to the left-hand brake arm by a rod and eccentric link; a releasing lever, with an eccentric pivoted to the connecting rod and link, enables the brake to be quickly released when required. When travelling, the lever is secured by a quick release strap and the connecting rod by a leather tie passed round it and the left tensile stay at the point of crossing.

The brake arms are actuated by the handle at the end or by the

cross handle near the centre of the actuating screw.

SHIELD.

The Mark II shield is of steel. It is in three parts, the upper and lower portions of which are hinged. The main portion is attached to the axletree by supporting brackets and to the trail by a flange with bolts. The lower portion, when travelling, is secured to the trail by a pawl, with a releasing lever and locking pin. The upper portion is lowered when travelling. The sight opening is provided with a hinged shutter for protection of the gunlayer when the rocking-bar sight is not in use; it is raised or lowered by a lever.

Leather cases and fittings are provided for carrying on the shield and axletree a dial sight, field clinometer, sight clinometer, spare parts, fuze keys, shovel, aiming posts, breech and muzzle covers, oil can, fuze indicator and tool case. An advance loop is fitted to the centre of the shield.

The Mark I differs from the Mark II in being formed in two parts and in being strengthened by wood slats.

AXLETREE AND WHEELS.

The axletree (2nd class, "C" No. 206) is a tubular steel forging; it passes through bearings on the carriage body and trail and is secured by a centre pin which passes through the trail bracket and axletree and two outside pins which pass through the brackets fitting over the axletree against the outside of the carriage body bearings, one either side and the axletree itself. A bracket feathered to each shoulder of the axletree is recessed on its outer face for the reception of an L-shaped leather ring, which is secured by a steel plate. The L-leather envelopes the inner end of the pipe box and prevents the ingress of dirt, dust, &c. The outer end of each arm is fitted for a linch pin and an adjusting collar, which has a number of recesses (through which the linch pin passes) cut in one face; the recesses are of varying depths, from 0.2-inch to 0.5-inch, increasing by 0.05-inch, so that any reduction in the length of the pipe box, due to wear, may be adjusted.

The axletree is braced by a tensile stay on either side; the front ends of the stays are attached to the axletree brackets while their rear ends are bolted to the brake band on the trail.

The wheels are 2nd class, "C" No. 45, 4-ft. 8-in. diameter, with steel flanges, removable P.B. pipe box and a 3-inch steel tire with rounded edges. The flanges are of corrugated steel, connected by bolts which pass through the feet of the spokes. The inner flange is fitted with a steel ring to strengthen it and the outer flange with a centring ring. The pipe box passes through the centre of the flanges and is secured by a nut, which is prevented from working loose by a flat spring fixed to the outer flange which engages with one of a number of ratchet teeth on the rim of the nut. For future manufacture the spring and ratchet teeth will be replaced by a locking plate, which fits over the octagonal nut and has two arms through which it is bolted to the flange, the nave bolts being used for this purpose. A dust cap is screwed on the outer end of the pipe box; it

encloses the adjusting collar, linch pin and the end of the axletree arm. The inner face of the cap is recessed for the reception of a corresponding projecting ring on the nut, the cap being secured to the nut by a split keep pin. The pipe box is provided with a lubricating hole which is closed with a ½-inch screw.

The drag washer is free to revolve round the nut and is secured

by the dust cap.

On an emergency, a 2nd class, "C" No. 200A wheel may be used

to replace a No. 45 wheel.

The lifting jack will be applied from the front of the carriage under the outer hinges of the shield, when it is required to remove the wheels.

CARRIAGE, FIELD, Q.F. 18-PR., MARK I*.

The Mark I* carriage is the Mark I carriage modified to take the new pattern hydraulic buffer and air recuperator as described on pages 13 to 16.

CARRIAGE, FIELD, Q.F. 18-PR., MARK I**.

The Mark I** carriage is the Mark I carriage fitted with a new cradle embodying the modifications necessary to enable the new pattern hydraulic buffer and recuperator to be used.

SIGHTING.

The carriage is fitted on the left side with a rocking-bar sight with sight elinometer. It is also provided with a No. 7 dial sight and No. 2 carrier.

ROCKING-BAR SIGHT.

(Plate XII.)

The rocking-bar sight consists principally of a rocking bar and a sight bar. The rocking bar is pivoted horizontally at the frontend to an arm on the left trunnion of the cradle. A bracket is riveted to the underside at the rear-end to carry a sight elinometer. An open square socket is formed in the bracket for the reception of a similar shaped projection on the arc bracket of the range gear, by which the reciprocating motion of the elevating screw is conveyed to the bar. The rear-end is provided with a crosshead in which works a

traversing screw (with milled heads) and a nut which enables 5-degrees of deflection right or left to be given to the sight bar. Degrees of deflection are marked on a scale plate and minutes in multiples of 5 on a micrometer collar fixed to each of the milled heads of the

traversing screw.

The sight bar is pivoted vertically about its centre to a socket with an adjustable bush in the rocking bar. The rear-end of the bar is fixed to the traversing nut. The nut on the traversing screw is in two parts having a spring inserted to keep the halves apart; the object of this arrangement is to take up backlash in the deflection gear due to the wear of the screw. Two holders with caps secured by spring clamps are fitted to the bar. The holders originally carried a sighting telescope, the use of which, however, has since been discontinued with Field Artillery. The rear holder is fitted with a notched leaf hind sight for use in conjunction with an adjustable acorn-pointed fore sight at the front end of the bar for open laying, and a cap with chain is provided for the protection of the foresight when not in use. The rocking-bar sight is removable, being attached to the trunnion arm and are bracket by nuts and pins.

For future manufacture the sight bar will be fitted with an adjustable supporting bracket for attachment of a No. 1 collimator and a rubber eye-piece for the use of the gun-layer. A base plate is secured to the side of the sight bar by fixing screws, and the collimator supporting bracket is attached to the base plate by two adjusting screws. Two plates are provided for the purpose of locking the bracket and collimator, respectively. The rubber eye-

piece with its steel bracket fits in the rear holder.

The permanent angle for drift is given by the axis of the cradle trunnions being inclined at an angle of 1½-degrees, the left trunnion being the lower, so that as elevation is given, the gun muzzle moves to the left the necessary amount to correct for drift.

COLLIMATOR, No. 1.

The No. 1 collimator consists of a metal body in which are mounted a lens and wedge-shaped window. At one end of the lens an arrow point is marked, which, being in the focal plane of the lens, will, when seen through the lens, appear to be at an infinite distance.

The wedge-shaped window transmits light into the lens, thus

illuminating the arrow point.

USE.

With the layer's head a few inches from the collimator and one eye closed, the sight is traversed until the arrow point appears exactly on the aiming point. It is very important that when using the collimator one eye should be kept closed, otherwise considerable errors in laying may result.

CLINOMETER, SIGHT.

(Plate XII.)

The sight clinometer is used to allow for the "angle of sight." It admits of 20-degrees elevation or 20-degrees depression and is so constructed that it can be readily attached to the carrying bracket. The Mark I sight clinometer consists principally of a cradle with a worm spindle and a toothed are with a spirit level. The cradle is fitted on the underside with spring clips for the purpose of attaching the sight clinometer to the carrying bracket, the clips are actuated by means of a spiral spring placed horizontally between them, and the top of the cradle is provided with radial grooves, in which the toothed are slides. The worm spindle passes through the centre of the cradle and is supported at each end by movable bearings, one of which is pivoted to the cradle and the other is free to slide in grooves for a limited distance, so that the worm on the spindle may be disengaged from the teeth. in the arc when necessary for quick setting. The worm is kept up to its work by a flat spring which is attached at one end to the cradle, the other end taking a bearing on the underside of the spindle. An adjustable micrometer collar graduated to read minutes in multiples of 5 is attached to each end of the spindle. The arc consists of a toothed segment with a spirit level above, fitted with "Bubble, spirit glass 'L'"; it slides in the grooves on the cradle and the teeth engage with the worm on the spindle. An adjustable reader is attached to the arc for reading the elevation and depression scales on the cradle.

The Mark II sight clinometer is generally similar to the Mark I, from which it differs in minor details in order to facilitate manufacture.

The Mark II* sight clinometer is the Mark II converted by the replacement of broken "L" bubbles by the "Bubble, spirit glass 'P,'" the letter "R" is painted in red on the cradle immediately below the zero mark of the degree scale, signifying that the bubble is radium treated.

The Mark III sight clinometer is generally similar to the Mark I, except that it is fitted with the "Bubble, spirit glass 'P'," and for the purpose of readily distinguishing it from the Mark I the letter "R" is painted in red on the cradle. In the case of Mark I sight clinometers, which have had broken "L" bubbles replaced locally by "P" bubbles, the mark is advanced to Mark III and the letter "R" painted in red on the cradle, signifying radium treated.

The Mark IV sight clinometer is generally similar to the Mark III from which it differs in the design of clip attachment. The clip attachment is constructed so that the spiral spring is mounted in a perpendicular position and cannot possibly become detached without the clips being released by hand. The great advantage this method of spring attachment possesses over the horizontal method is that the sight clinometer is not apt to jump out of its carrying bracket when the gun is fired, as often occurs with the Marks I to III sight clinometers.

In future manufacture, sight clinometers will not be fitted with radium treated bubbles.

Existing sight clinometers will have the radium treated bubble replaced, as they become broken, by bubbles of the same size and sensitiveness, viz., the "L" or "N," or by the "P" from which the radium has been removed. When fitted with a non-luminous bubble, the letter "R" on the body of the sight clinometer, signifying radium treated, will be barred out and in the case of the Mark II* the Mark will revert to II and in that of the Mark III to I.

As issues of the Mark IV sight clinometer fitted with the "P" bubble have not been made to the Service, it will now be fitted with the "L" bubble before issue, but this alteration, however, will not affect the Mark.

SIGHT, DIAL, No. 7.

(Plates XIII and XIV.)

The No. 7 dial sight is employed for both direct and indirect laying. The upper part can be revolved horizontally through a complete circle independently of the eyepiece, thereby allowing the layer to see objects in any direction without moving the position of his eye. Owing to the height of the sight the layer can lay on objects directly behind him, the line of sight being above his head. A coned seating in the sight rests on a coned projection on the carrier.

Mark III.—The optical arrangements are so designed that an object viewed through the sight is always seen erect. They consist

of :--

F. The upper prism which is mounted in the upper portion of the sight. Its face can be turned in any direction with reference to the eyepiece K, the angle between the two being indicated on the dial plate and by means of a reader on the bracket N.

G. The centre prism which by means of bevel gearing is made to revolve at half the speed of the upper prism F. This arrangement

ensures the object laid on always appearing erect.

H. A double reflecting roof prism.

J. The object-glass.

K. The eyepiece, with two eye lenses.

M. A glass diaphragm, upon which are engraved vertical and horizontal lines with gaps near their centres; a radium dot is placed just below the optical centre on the vertical graticule and is for use at night. A glass window in the eyepiece allows the lines to be illuminated at night.

The magnification of the system is four diameters, and the field of view is 10°. There are no arrangements for focusing the sight.

The principal mechanical parts are the following:-

B. The supporting pillar, in which are suitably mounted the eyepiece K fitted with a dermatine eyeguard, the lower prism H and the object-glass J. The "plug, supporting pillar," V, is screwed into its lower end and on it is a castellated nut, which is prevented from unscrewing by a split-pin. Near the upper end of the supporting pillar is a coned seating W, which fits accurately on to a coned bearing on the carrier.

The projection X, which fits into a slot in the carrier, prevents the sight revolving, and is also the means by which the dial sight is adjusted for line when in use with carriers fitted with dial sight adjusting screws and lock nuts.

C. The worm-wheel bracket is firmly secured to the supporting pillar B. In it is mounted the slow motion traversing gear, which consists principally of a worm spindle S, the worm on which engages with the worm-wheel D. On either end of the spindle is mounted a milled head and an adjustable micrometer scale drum. The drums are graduated in opposite directions in divisions of 10-minutes, Right angles being denoted by white lines on a black background and left angles by black lines on a brass background. For future manufacture the distinctive marking will be omitted, the graduations being filled in with black wax on a bright metal background, Right and Left angles being indicated by the letters "R" and "L" respectively. The drums can be adjusted by loosening the caps inside the milled heads and turning them independently of the milled heads. The readers for the drums are on the worm-wheel bracket. Each turn of the worm spindle moves the upper part of the sight through 5°. The worm spindle is mounted in an eccentric, which, when turned by raising a lever near the left drum, throws the worm out of gear with the worm-wheel. This enables the upper part of the sight to be revolved rapidly. The rear surface and four screws are for the attachment of the upper portion of the deflection bracket of the No. 1 Special and Nos. 2, 4 and 5 Carriers, but in future manufacture carriers will not be provided with deflection brackets and all deflection angles will be applied through the dial sight.

D. The worm-wheel has teeth cut on its lower portion which engage with the worm spindle S. It extends upwards and is firmly secured to the upper prism holder E and the dial plate A by screws, &c.

Y. The centre prism holder fits accurately in the supporting pillar B. To it is attached the prism mount P, in which the centre

prism G is firmly held.

The prism holder is free to revolve and is forced to do so at half the speed of the upper prism holder E, by means of three bevel wheels. The axis of the vertical bevel wheel Z is formed on a projection from the prism holder. This wheel engages with the lower bevel wheel Z^1 , which is fixed to the supporting pillar and also with the upper bevel wheel Z^2 , which is fixed to the upper part of the sight. When the upper part of the sight is revolved the axis of the centre bevel wheel and consequently the central prism, are forced to revolve at half the speed of the upper part of the sight.

E. The upper prism holder, as previously mentioned, is rigidly attached to the dial plate and worm-wheel. In it are suitably mounted the upper prism and a glass window.

A Mark I. diaphragm is hinged to the case of the upper prism holder by means of which the focus and parallax at short distances

can be corrected without any appreciable loss of light.

The diaphragm, which is fitted with a shutter, is only for use at short distances of, approximately, 20-yards or under.

A spring is provided which retains the diaphragm in position when closed.

In the centre of the diaphragm is a hole, 0.25-inch in diameter, in the shutter one of 0.125-inch diameter.

If the object to be viewed is only a few feet away, the shutter is to be used and the object viewed through the small hole.

When the dial sight is used at a distance of more than 20-yards the diaphragm is to be lowered from the front of the window.

The Mark II. diaphragm differs from the Mark I. principally in the following particulars:—

The hinge pin is of strengthened pattern.

The shutter can be operated from the outside, and it is not necessary to lower the diaphragm.

The spring retaining the diaphragm is of an improved design and also retains the shutter.

To enable the line of sight through the upper prism to be elevated or depressed, a small toothed are is attached to the mount of the prism. The teeth of this are are engaged with a worm spindle R. At the top of this spindle is mounted a milled head with adjustable drum, engraved with a zero mark. The reader is engraved on the prism holder; 17° elevation or depression can be given. The letters "E" and "D" are engraved against each numbered graduation to denote "Elevation" and "Depression," respectively.

A crosshead with open sights (or view finder) is mounted on the right side of the upper prism holder. Its movement is regulated by that of the upper prism, but, as the latter has a reflecting surface the former has to move twice as quickly. This is arranged for by a toothed wheel on the prism mount, gearing with a toothed wheel having only half the number of teeth, on the pivot of the crosshead with open sights.

Engraved on the under portion of the crosshead is a zero mark, indicated by an arrow on the upper prism holder.

A. The dial plate, as previously mentioned, is firmly fixed to the worm-wheel and upper prism holder. The dial plate is cast with two lug pieces on it to prevent any play between the dial plate and the case, upper prism holder. Two scales, each reading from 0 to 180 in single degrees, are engraved round the dial plate, right angles being denoted by white lines on a black background and left angles by black lines on a brass background. For future manufacture the distinctive marking will be omitted, the graduations being filled in with black wax on a bright metal background; right graduations being indicated by the letter "R" the left by the letter "L" The graduations are read by a reader on the reader bracket. This reader can be adjusted by loosening two screws in its rear surface and moving it to one side. The amount of adjustment that can be thus obtained is approximately 11 degrees on either side of zero, but instructions will shortly be announced in List of Changes for the adjustment to be increased to 2 degrees for existing sights, whilst those of future manufacture will have an adjustment of 21 degrees each way.

The Mark II dial sight differs from the Mark III principally in the following particulars:—

- (1) The dial plate is not cast with two lug pieces on it.
- (2) The slope of the dial plate is steeper and causes the reader plate to be slightly lower.
- (3). The boss at the top of the dial plate is slightly smaller in diameter, necessitating a smaller clamping collar and lead lining.
- (4) The vertical scale graduations on the upper prism holder crosshead and the micrometer head, excepting the zero and index marks, are omitted.

Mark I sights differ from the Mark II in the following particulars:—

One of the milled heads on the worm spindle is smaller.

A vertical scale, with graduations to 15° elevation and depression, is fixed to the upper prism holder and the micrometer scale drum is graduated in intervals of 10-minutes.

Certain internal parts are of steel instead of bronze.

Marks I and II sights are brought up to Mark III type when passing through Woolwich for repair.

CARRIERS, No. 7 DIAL SIGHT.

Carrier, No. 7 Dial Sight, No. 2, Mark I.—The No. 2 carrier consists of a steel bar, shaped at its lower end to fit into a supporting bracket on the arc bracket of the range gear. The upper portion is

shaped to take the dial sight.

To enable deflection to be given to the sight, a bracket, on which worm teeth are cut, is fixed by screws to the back of the carrier. Gearing with the worm teeth is a worm formed on the centre of a spindle, which works in bearings in a bracket attached to the back of the dial sight. The worm spindle has milled heads with micrometer scales, graduated in intervals of 10-minutes, and the worm spindle bracket carries a deflection scale plate, graduated to '10-degrees R. and L., the graduations being indicated by an arrow plate attached to the carrier.

The No. 2, Mark II is made of cast iron and is generally similar to the No. 2, Mark I, except that the deflection bracket is omitted, a projection is formed at the top of the carrier to act as a stop, and the diameter of the coned seating is of increased dimensions to enable the dial sight to take a bearing on the side of the cone instead of the top surface. Existing Mark I carriers will be modified to approximate to the Mark II by having the deflection bracket removed and a stop bracket† fitted to prevent the dial sight from turning in the carrier. Carriers thus modified will have a "*" added to the Mark and in the future be known as Mark I*.

[†] A number of No. 2 Mark I carriers have been fitted with a stop bracket in accordance with § L. of C. 20181; this method will be superseded by a simpler method which is described in § L. of C. 23722, but carriers already modified will not be affected.

INSTRUCTIONS FOR TESTING AND ADJUSTING THE SIGHTS.

The field clinometer, sight clinometer and elevation indicator should be tested daily and after prolonged firing. The alignment tests should be carried out as often as possible.

Any adjustment to optical instruments must be carried out by a

qualified artificer.

TEST 1 .- TO TEST AND ADJUST THE FIELD CLINOMETER.

To ascertain the index error.—Set the clinometer at zero; place it on the clinometer plane and elevate or depress the gun until the bubble is in the centre of its run; then turn the clinometer end for end.

If the bubble is still in the centre of its run the clinometer is in adjustment. If the bubble is not in the centre of its run bring it so by moving the slider or, if necessary, the arm and slider. One-half of the nett reading is the index error of the clinometer. If the bubble cannot be brought to the centre of its run by this method, the error of the clinometer may be determined by comparison with a clinometer of known error.

To eliminate an index error.—Set the elimometer to read the ascertained index error, place it on the elimometer plane, and bring the bubble to the centre of its run by elevating or depressing the gun. Set the instrument at zero, replace it on the elimometer plane, and with the instrument in that position bring the bubble to the centre of its run by manipulating the adjusting screws of the bubble tube, the gun remaining as before.

Reversing the instrument end for end should not alter the central position of the bubble; should it do so, proceed as before

until there is no change.

The adjustment to the bubble is made by two capstan nuts in the Mark III, by three grub screws in the Marks IV and V, and by a clamping and adjusting screw in the Mark VI.

To ascertain if the bubble axis remains parallel to the longer axis of the clinometer (Roll test).—Having adjusted for index error, set the clinometer to read zero, place, it on the clinometer plane and bring the bubble central by the elevating gear.

Revolve the clinometer on its longer edge through an angle of 5-degrees to either side, care being taken that the longer edges of the clinometer are approximately parallel to the axis of the gun.

The air bubble should remain central. If it moves from the

centre, the instrument requires adjustment.

To adjust.—If the bubble travels towards the rack, when revolved on its long edge, loosen the lower grub screw next to the edge on which it is revolved, and tighten the other lower grub screw until the bubble is again central. If the bubble travels away from the rack when revolved, reverse the operation with the lower grub screws. The clinometer should now be tested for index error.

OFFICIAL COPY.

[Issued with Army Orders for September, 1922.

W.O. 8407

Amendments (No. 1) to the Handbook of the Q.F. 18-pr. Guns on Carriages, field, Marks I* to II.

1922.

Page 28-

Line 25:-

For "+15 minutes" substitute "-20 minutes"

Lines 30 and 31:-

For "clinometer plane at the muzzle, are to the front" substitute "left guide rib near the muzzle, are to the rear."

September, 1922.

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The Marks IV and V clinometers can be adjusted in this manner, but the Marks III and VI are not so adjustable.

These adjustments to elinometers should only be carried out by those qualified to perform them.

TEST 2.—TO TEST AND ADJUST THE SIGHT CLINOMETER.

With the sight elinometer bracket horizontal and the sight elinometer reading zero, the bubble of the sight elinometer should be in the centre of its run.

Place the sight clinometer, set at zero, in its bracket and bring the bubble to the centre of its run by the left elevating handwheel. Reverse the sight clinometer end for end; the bubble should still be in the centre of its run.

If the bubble is not in the centre, bring it so by turning the micrometer head. Note the reading and set the micrometer scales to half this reading. Bring the bubble to the centre of its run by the left elevating handwheel. Slacken the nuts securing the micrometer scales and the serews securing the degree scale; shift the micrometer scales and reader to zero and re-clamp.

TEST 3 .- TO TEST AND ADJUST THE ELEVATION INDICATOR.

With the sight clinometer reading zero and the bubble in the centre of its run, and with the axis of the gun inclined at the necessary angle to the line of sight to compensate for jump and droop, the elevation indicator should read zero. If the jump of any particular equipment has not been determined it will be taken as + 15 minutes.

Place a shell in the chamber to take up play in the elevating gear. Set the M.V. corrector at 1615.

Set the sight clinometer at zero and bring the bubble to the centre of its run by the left elevating handwheel; place the field clinometer set at the correction for jump on the clinometer plane at the muzzle, are to the front. Bring the bubble of the field clinometer to the centre of its run by the right elevating handwheel. The elevation indicator should read zero.

If the elevation indicator does not read zero, slacken the nut, revolve the indicator until it reads zero and re-clamp.

Set the M.V. corrector at the muzzle velocity of the gun.

ALIGNMENT TESTS.

Before beginning these tests the following preparations should be made:—

(i) Place the carriage on a firm platform and manipulate it until it is level transversely. See (iv).

- (ii) Select a well-defined object at least 1,500-yards distant on which to lay.
- (iii) If this distant object cannot be found, set up the target testing sights (see Plate XV) about 50-yards in front of the gun at right angles to the axis of the bore.
- (iv) If the carriage cannot be levelled transversely the top of the dial sight carrier and the target testing sights should be sloped to the same angle as the carriage.
- (v) Remove the striker and fix cross wires at the muzzle of the gun. (The cross wires must be removed on completion of test, otherwise accidents may occur when firing.)
- (vi) Set the elevation indicator, the cowl of the dial sight, the dial plate and micrometer scales of the dial sight and the deflection scale of the open sight at zero.

TEST 4.—TO TEST AND ADJUST THE DIAL SIGHT AND OPEN SIGHT FOR LINE.

The lines of sight through the dial sight and open sights should

be parallel to the axis of the bore as regards line.

Lay the bore on the distant object for line by the left elevating handwheel and the traversing gear, using the inter-section of the cross wires as a fore sight and the hole in the firing-hole bush as a hind sight. The lines of sight through the dial sight and open sights should be on the distant object.

When using the target testing sights (see Plate XV) lay the bore on point B; the dial sight should be on line D, and the open

sights on line S.

If the dial sight is not in alignment, turn the micrometer heads of the sight until it is; loosen the caps inside the milled heads and without turning the milled heads put the scales back to zero and tighten up the caps. Slacken the screws securing the dial plate reader, move the reader to zero and tighten up the screws. If the open sights are not in alignment, adjust by turning the adjusting bush on the pivot of the sight bar and tighten up the fixing screw and adjusting bush.

TEST 5.—TO TEST AND ADJUST THE OPEN SIGHTS FOR ELEVATION.

The line of sight over the open sights should be parallel to the

sight elinometer set at zero.

Set the sight clinometer at zero and bring the bubble to the centre of its run by the left elevating handwheel; place the bar testing sights on the open sights, and place the field clinometer set at zero on the bar testing sights. The bubble should be in the centre of its run.

If the bubble is not in the centre, bring it so by slackening the fixing screw and screwing the fore sight up or down and re-clamp.

LIMBER, Q.F. 18-PR., CARRIAGE.

(Plates XVI and XVII.)

The Mark II limber consists of a steel frame, a limber hook, a 2nd class axletree, draught fittings, an ammunition box and two field wheels.

The frame consists of four futchels, connected at the front end by a trough-shaped splinter bar and at the centre by stays. Platform and foot boards are fitted to the top and draught hooks for the swingletrees to the front of the outer futchels. A steel limber hook, No. 31, is riveted to the rear-end of the inner futchels.

The axletree, No. 252A, is of weldless steel tube: it is fixed by flanges to the futchels. The linch pin and adjusting collar are

similar to those for the carriage.

The fittings for draught consist of a No. 17 Mark III pole, a No. 3 supporting bar and two No. 11 swingletrees. The pole and bar are for use with the R.A. pole draught breast harness. The pole is 12-feet 4½-inches in length over all; the front-end is protected by steel wrapping plates; a U-shaped tug is passed through the pole from the underside and secured by a nut on the top. The tug forms a stop for the pole bar and its position from the point of the pole may be varied from 14½-inches to 29½-inches, in distances of 3-inches, according to requirements. The pole bar is 3-feet 9½-inches in length, fitted at the centre with an oval loop, formed to pass over the front end of the pole and butt against the tug. Two links are fitted on each side of the loop, by means of which the bar is attached to the neck piece of the harness. The swingletrees are 2-feet 6-inches long.

The ammunition box is of steel and opens at the rear; it is constructed to carry 24 rounds of "fixed" ammunition, is fitted with guard irons, Nos. 25 "near" and 26 "off," is secured to the frame by rivets and supported by side connecting plates and gusset plates. Internally it is fitted with 24 tubular baskets secured by leather stops. The baskets are shaped internally to hold one round. A compartment is formed in the centre for two wood trays for small stores. The lid (the inside of which is covered with a leather or waterproof canvas pad to prevent the ingress of water) is hinged to the bottom of the box and is provided with a shield plate of the same width, which hangs vertically below the lid when opened. The shield plate is hinged to the lid and when closed, the former is folded over the latter, which is secured by catches on each side

of the box.

Spring clips are attached to the front of the box for carrying two rifles, in canvas covers, secured in position by means of "quick release" securing straps.

The limber is fitted on the underside with wire net receptacles for carrying canvas water buckets, with fittings to carry a 3-lb.

grease tin and two No. 3 lubricating cans (one for Rangoon and one for buffer oil); also various stores as shown in Packing Diagram, page 39.

The wheels are the same as those described for the carriage.

Half the limbers per battery will be fitted with loops for kicking

straps.

The Mark I limber differs from Mark II in being fitted with brass tubes instead of tubular baskets for carrying the ammunition.

LIMBER, Q.F. 18-PR., WAGON.

(Plates XVIII and XIX.)

The Mark II wagon limber differs from the carriage limber principally in the form and capacity of the ammunition box, which is constructed to carry 38-rounds and one tray for small stores. It is provided at the rear with three lids, one on each side and one in the centre. The side lids are fitted with shield plates which hang below the limber frame, as in the carriage limber; the centre lid is hinged at its upper edge and rests on the top of the box when open.

The Mark I limber differs from Mark II in being fitted with brass tubes instead of tubular baskets for carrying the ammunition.

WAGON, AMMUNITION, Q.F. 18-PR.

(Plates XX and XXI.)

The Mark II wagon consists of a steel frame, hollow box perch fitted with a perch eye, steel ammunition box, brake gear, 2nd class axletree and two field wheels.

The frame consists of two flanged sides connected by stays, platform and foot boards are fitted to the sides and perch in front, and a shelf is fitted under the platform board on each side of the perch to carry a 3-lb. grease box.

The perch, which is connected to the frame by the side stays and platform boards, is plugged at the front end with hard wood. It is fitted with locking plates, lifting handles and a No. 13 perch eye.

The ammunition box is the same as for the wagon limber, except that it has only one lid fitted with a shield plate similar to that for

Note.—To facilitate the extraction of ammunition from the baskets the leather work of the basket should be kept soft by grease. The baskets will be tested periodically and if necessary, rectified by the insertion of a dummy round.

the carriage limber. Fittings are also provided on top of the box in rear for the fuze indicator.

A tire brake is provided, which acts on the front of the wheels and is actuated from the rear by a handwheel.

The wagon is fitted to carry a spare jointed pole and the various stores as shown in Packing Diagram, page 40.

The axletree is 2nd class "C" No. 252A. The wheels are similar

to those for the carriage.

A "Connector, limbering," consisting of an axletree hook with connecting pin and a coupling hook with two links, is attached to the axletree as a component of the wagon and affords a ready means of connecting the carriage to the wagon in cases where only one limber is available.

The Mark I wagon differs from Mark II in being fitted with brass tubes instead of tubular baskets for carrying the ammunition.

AVERAGE WEIGHTS.

(Fully packed with ammunition and stores, but without men or personal equipment.)

	_ w	eights.	
	ewts.	qrs.	lbs
Carriage with gun.	27	2	3
Culture with games	15	ī	ő
Limber { carriage	19	ō	ő
wagon [with spare jointed pole	19	3	17
Wagon, ammunition { with spare jointed pole	19	1	17
Carriage and gun with limber	42	3	3
Carriage and gun with limber Wagon, ammuni- with spare jointed pole	38	3	17
tion and limber \ without spare jointed pole	38	1	17
f maight an fara mhaala	16	ō	21
Carriage and limber weight on hind wheels	21	ĭ	0
(weight on fore wheels with spare	(T) (T) (1)	-	
jointed pole	20	2	5
weight on hind wheels with spare			
Wagon, ammuni- jointed pole	18	1	12
tion and limber weight on fore wheels without		-	
spare jointed pole	20	0	14
weight on hind wheels without			
spare jointed pole	18	1	3
(without men			24
Weight on pole at carriage and with 2 men on			
tug 3rd hole limber limber		1	4
from front end wagon and [without men			20
(limbered up) limber with 2 men on limber	_	1	0
Carriage—		-	
Pressure of trail on ground	1	0	8
Pressure of trail on limber hook	-	3	4
Wagon, ammunition—			
Pressure of perch f with spare jointed pole	1	3	16
on ground without spare jointed pole	ī	3	4
Pressure of perch f with spare jointed pole	ī	0	20
on limber hook without spure jointed pole	î ·	o	ő
Wheel, 2nd Class "C" { No. 43	î	2	10
Wheel, 2nd Class "C"	î	3	10

DIMENSIONS, &c.

•	Carriage and Limber.	Ammunition Wagon and Limber		
	ft. ins.	ft. ins.		
(to axis of gun	3 0.86			
to line of sight	3 9.11	_		
Height to line of sight	4 8.75			
maximum { limber	4 9	_		
wagon and limber	• _	5 2		
Width, maximum	6 3	5 2 6 3		
Corringo with gun	13 8	" -"		
with pole.	14 2	_		
carriage without pole	13 8 14 2 5 4.5	_		
Length of limbers carriage with gun without pole wagon without pole with pole with pole with pole.		14 2		
wagon without pole	~			
wagon		5 4.5 8 5 7 4.75		
(between axletrees	9 11	7 4.75		
Length with pole (end of pole on ground)	27 4.5	21 5.5		
without pole	18 9	12 11		
Greatest projection beyond track of wheels				
Wheels Strack	- 6 5 3	5 3		
Wheels { track	5 3 4 8	- 6 5 3 4 8		
Space required to turn in	32 0	28 0		
	degs. mins.	degs, mins.		
Analoge Clock	71 0	64 0		
Angle of { lock	14 18	_		
Upsetting angle	39 30	35 30		
Elevation, maximum	16 0	_		
Depression, maximum	5 0	1 -		

PART IV.

LIST OF STORES AND PACKING DIAGRAMS.

LIST OF STORES.

CARRIAGE.

·	CARI	RIAGE.	
Articles.		No.	Where carried.
Axe, pick Brush, breech screw Can, lubricating, No. 9 Carrier, No. 7 dial sight, No. 2 Cases, keys, setting fuze , field clinometer, No. 1		1	Under trail. In tool case, rear of shield. In wood block, rear of shield. On shield, in case.
"No. 7 dial sight and car 13 and 18-pr "sight clinometer "spare parts "spare parts		1 1† 1 1*	On left tensile stay
", sight clinometer ", tools " " Cleaner, piasaba, No. 18 wool, No. 1		1 1 1	On left tensile stay. On shield. In tubular trail.
Clinometer, field sight	(spare)	1§ 1* 1 1	On rear of shield. In case, on left tensile stay. In case, on shield. On gun; when not in use strapped to front of shield.
muzzle, No. 1 " eccentric brake gear Drift, No. 12 Gauge, striker protrusion, No. Hammer, claw (24-oz.)		1 1 1	On eccentric of brake gear. In leather case, on shield. In tool case, rear of shield.
Indicator, fuze, Q.F. 18-pr. Key, removing jammed cartrid	 lge, Q.F.	2 1 1*	In tool case. On shield. In tool case, "A" sub-section.
Lanyard, firing, No. 15	pints	1 1 2	In tool case, rear of shield. In lubricating can.
Pin, axis, catch, B.M. lever Pins, firing Springs, main , safety catch , trigger		155 15 2 155 155 155 155 155 155 155 155	In leather case, on shield.
Strikers	prs.	1 1 2	In tool case, rear of shield.
Screwdriver, G.S., 4-in Shovels, G.S Sight, dial, No. 7	prs.	1 1 1	In leather case, on shield. Right tensile stay. On shield in case.
Spanner, hydraulic buffer, No. 1 ,, No. 244 ,, hydraulic buffer, No. 1	69	1 1	In tool case, rear of shield.
, , , , , No. 1 , , , , No. 1 , , , No. 1	71 74	1 1 1	Per section. 22 8 per battery

LIST OF STORES—continued. Carriage—continued.

		10	Artic	les.				No.	Where carried.						
Spanne ,, Tommy		"		uffer	No.	172 173 176	···	1 1 1	In tool case (or cases) or axletree.						
,,	No.	40			•	•••		ì	In case (or cases) on axletree.						

LIMBERS, CARRIAGE AND AMMUNITION WAGONS.

Axes, pick 1 2 Under limber. Bar, supporting draught pole, No. 3 (spare) 1 1* On platform board. Blankets, G.S 2 2 0 n top of limber box.	Articles.	Carriages.	Wagons.	Where carried.
No. 3	Axes, pick			On platform board. Under limber.
Boxes, grease, 3-lb 1 Boxes, dust cap and drag washer Breastpiece 1 Brush, water, carriage 1 Brush, water, carriage 1 Buckets, water, G.S., canvas 12 Buckets, water, G.S., canvas 14 Buckets, water, G.S., canvas 12 Bunder platform board, "near side. Bunder platform board, "near side. Bunder platform board, "near side. Buckets, water, G.S., canv	No. 3 (spare)			On platform board.
Boxes, dust cap and drag washer Breastpiece		100000		Under platform board, "near
1	Boxes, dust cap and drag washer	1†	_	On footboard, "near" side.
Brush, water, carriage 1 1 1 1 2 6 2 2 2 2 2 2 2 2	Dagastnicas	1	1	On platform board.
Cans, lubricating, No. 3 (for Rangoon oil)		1	1	Under platform board, "near
Cans, lubricating, No. 3 (for mineral oil)		12.	6)
Caps, dust, 2nd class "C" capped wheels, No. 1 (spare) Carrier, ammunition, Q.F. 13 and 18-pr	Cans, lubricating, No. 3 (for			
wheels, No. 1 (spare) Carrier, ammunition, Q.F. 13 and 18-pr	Caps, dust, 2nd class "C" capped	1	1	J
18-pr	wheels, No. 1 (spare)	1†	-	In box on footboard, "near side.
Cartridges, Q.F. 18-pr 24 38 38 On cartridges. Clips, cartridge, Q.F. 18-pr 5 3 Under tray, small stores. Clars, adjusting, 2nd class "C" capped wheels (spare) Covers, rifle 2 2 On rifles, front of ammunition box. Crowbars, 4-ft. 1-in 1+ 1-	10	,	,	Under blankets
Clips, cartridge, Q.F. 18-pr 24 5 5 Under tray, small stores. Collars, adjusting, 2nd class "C" (spare) 1‡ — Tray, small stores, lower. Covers, rifle 1† — On rifles, front of ammunitio box. Crowbars, 4-ft. 1-in 1† — On platform board. Clies, smooth, flat, 6-in 1 — S-in 1 — S-in 1 — Tray, small stores, lower. " hand, safe-edge, 8-in 1 — Tray, small stores, lower. " 2nd cut half-round 6-in 1 — Tray, small stores, lower. " 2nd cut half-round 6-in 1 — Tray, small stores, lower. " 3nd cut half-round 6-in 1 — Tray, small stores, lower. " 1n grease box. On platform board. Tray, small stores, lower. Under tray, small stores, lower. " 1 Under tray, small stores, lower. " 2 Under tray, small stores.	Cartudges OF 18 pr			
Cloths, sponge	line cartridge OF 18-m			
capped wheels (spare) Covers, rifle	Cloths, sponge	100000000000000000000000000000000000000	1077 (33)	Under tray, small stores.
Crowbars, 4-ft. 1-in 1+ - On rifles, front of ammunitio box. Crowbars, 4-ft. 1-in 1+ - On platform board. Files, smooth, flat, 6-in 1 On platform board. Sin 1 On platform board. Tray, small stores, lower. Tray, small stores, lower. In grease box. On platform board. Tray, small stores, lower. On platform board. Tray, small stores, lower. Under platform board, "off side. Under tray, small stores.	capped wheels (spare)	11	_	Tray, small stores, lower.
Files, smooth, flat, 6-in			2	On rifles, front of ammunition box.
" " hand, safe - edge, 8-in 1 " 2nd cut half-round 6-in 1 " 3 3 3 In grease box. Handle, air pump 1 " 6lie, small 1 Hooks, bill 1 " 1 Under platform board, "off side. Holder, cartridge 1 " 1 Under tray, small stores.	Crowbars, 4-ft. 1-in			On platform board.
8-in 1 3 2nd cut half-round 6-in 1 3 3 3 In grease box. 4 Andle, air pump 1 5 File, small 1 6 Hooks, bill 1 6 Holder, cartridge 1 6 Holder, cartridge 1 8 In grease box. 9 On platform board. 1 Tray, small stores, lower. 1 Under platform board, "off side. 1 Under tray, small stores.	Files, smooth, flat, 6-in	1	-	
" 2nd cut half-round 6-in Grease, lubricating lbs. Handle, air pump " if le, small Hooks, bill Holder, cartridge Holder, cartridge " In grease box. On platform board. Tray, small stores, lower. Under platform board, "off side. Under tray, small stores.	0 :	1		Tray, small stores, lower.
Grease, lubricating lbs. 3 3 In grease box. Handle, air pump 1 - On platform board. Hooks, bill 1 1 Under platform board, "off side. Holder, cartridge 1+ Under tray, small stores.			_	
Handle, air pump 1† — On platform board. "Tray, small stores, lower. Holder, cartridge 1 1 Under platform board, "off side. "The platform board, "off side. "Tray, small stores, lower. "Under platform board, "off side. "Under tray, small stores.	Grease, lubricating lbs.		3	In grease box.
Hooks, bill 1 — Tray, small stores, lower. Under platform board, "off side. Holder, cartridge — 1++ Under tray, small stores.	Handle, air pump	1+	_	On platform board.
Hooks, bill 1 1 Under platform board, "off side. Holder, cartridge – 1++ Under tray, small stores.	" file, small		!	Tray, small stores, lower.
Holder, cartridge 1++ Under tray, small stores.	Hooks, bill	1	1	Under platform board, "off
				100000000000000000000000000000000000000
Keys, No. 17 (fixing tuze) 1** 1 Tray, small stores.				Under tray, small stores.
	Keys, No. 17 (fixing tuze)	1**	1	1ray, small stores.

LIST OF STORES—continued.

Limbers, Carriage and Ammunition Wagons—continued.

Articles.	Carriages.	Wagons.	Where carried.
Implements, ammunition-			
Keys, No. 27 (primer)	_	1+	Tray, small stores.
" No. 18 (setting fuze)	2*	2	,, ,, ,,
Keys, split, flat, 1-in. × 4-in. (spare)		-	, , lower.
Key, spring lock	1	1	On outside of lid in pocket.
Line, Hambro'	1	1	On platform board.
Oil, mineral (for buffers) pints	2	2	In cans, lubricating.
Oil, Rangoon ,,	11/2	11/2	1)
Pins, capsquare (spare)	1	-	Tray, small stores, lower.
Pins, keep, split, 16-in. × 11-in.	1	_	
", ", $\frac{3}{32}$ -in. $\times 1\frac{1}{2}$ -in.	1	-	-
", ", $\frac{3}{32}$ -in. $\times 1\frac{3}{4}$ -in.	2		
(spare)	3 2	200	Tray, small stores, upper (i
", ", $\frac{1}{5}$ -in. \times 1-in. $\frac{1}{5}$ -in. \times 2 $\frac{1}{2}$ -in.	ĩ		box, spare springs, &c.).
lin v 11 in			20 20 00 00 00 00 00 00 00 00 00 00 00 0
" " g-III. X 14-III. (spare)	9		
,, ,, is-in. × 1-in.	ĩ	-	
	1		Tray, small stores, lower.
Pins, linch, 2nd class "C" capped (spare)			
wheels (spare)	18	- 1	Tray, small stores, lower.
Pin, locking, shield pawl (spare)	1		Tray, small stores, lower.
" draught, No. 3 (spare)	1		firay, smail stores, lower.
Plate, locking nut, pipe box, 2nd		. 1	m
class "C" wheels (spare)	1§	-	Tray, small stores, upper (ir
cump, air, two stage, horizontal,	10	- 1	rectangular tin box).
No. 2	1§	-	In box, strapped on top, at rear of limber box.
Primers, percussion, Q.F.	- 1	1	rear of number box.
cartridges, No. 1 (in tin box) (spare)	_ 1	4	Tray, small stores.
Ropes, drag, light, G.S. pairs	_		On platform board.
crewdriver, G.S. 4-in			Tray, small stores.
crews, lubricating hole, boss-	ADMINITE IN	-	
head is × 1-in. (spare)	2	- 1	Tray, small stores, upper (in
			rectangular box).
hovels, G.S	1	2	On platform board.
pades, Mark III	1	2†	On "off" side of limber box.
prings, shield pawl, Q.F. 13 and		1.	
18-pr (spare)	1	- 1	Tray, small stores, lower.
" sight clinometer (spiral)			
Q.F. 18-pr. (spare)	1	- 1	", " " upper (in
plup can travaraing laws		1	rectangular tin box).
,, plunger traversing lever,	1++	_ /,	Tray, small stores, upper.
Q.F. 18-pr (spare) raps, supporting, front (spare)	2	2	ing, smar stores, upper.
" " rear (spare)	ĩ	î	On platform board.
,, trace (spare)	2	2	r r
orings, catch, limber and perch		'	
hooks (spare)	11	- 7	Fray, small stores, upper.
" disc, No. 62 (spare)	17	- 17	
" firing gear (spare)	1**	- }	Tray, small stores, lower.
10.7	1		000000 0000000000000000000000000000000
* Tray, small stores, lower.		8	Per section.
† One each side of limber box.		Ĭ.	Per battery.

[†] One each side of limber box.

‡ When limbers are fitted with new pattern hooks.

Per section.
Per battery.
4 per battery.
†† 1 per 3 guns.

LIST OF STORES—continued. Limbers, Carriage and Ammunition Wagons-continued.

Articles.	Carriages.	Wagons.	Where carried.				
Swingletrees, Nos. 10A or 11 (spare) Syringe, extracting liquid Traces, saddlery pairs Tugs, trace (spare) Washers, drag, 2nd class "C"	1 1* 1 2	1 2	On platform board. Under lower tray, small stores. On platform board.				
capped wheels (spare) Wrench, adjusting, No. 7 dial sight and carrier	1*	-	In box on footboard, "near' side. Tray, small stores, upper.				

AMMUNITION WAGONS.

Articles.	No.	Where carried.
Bar, testing, rocking-bar sight, Q.F. 13 and 18-pr	1(a)	In box, on platform board.
Blankets, G.S Box, bar, testing, rocking-bar sight,	2	On top of ammunition box.
Q.F. 13 and 18-pr. Box, lamp, siege, to hold 2 Boxes, grease, 3-lb. Bush, testing, sighting, 3·3-ın.(c) Cartridge, Q.F. 18-pr Cases, saw, hand Catch, limber hook, No. 2 (spare) Clips, cartridge, Q.F. 18-pr. Grease, lubricating lbs. Handspike, common, 6-ft. Implements, ammunition—	1(a) 1;; 2 1; 38 2 1*§ 38 6 1	On footboard. Under platform board. In tray, small stores. In ammunition box. Lid of ammunition box. In tray, small stores. On cartridges. In boxes. Under perch.
Keys, No. 18 (setting fuze) Indicator, fuze, Q.F. 18-pr	$\frac{2}{1(b)}$	
Kettles, camp, oval, 12-qts Lamps, siege Lashings, tarred, 1-in. × 20-ft " , 1-in. × 10-ft Line, white, 1-lb. skeins Nut, actuating screw, carriage, Q.F. 13 and 18-pr (spare)	2§§ 1† 3† 1	firing battery wagons. Under wagon, as required. In box. Under wagon, as required. Under tray, small stores. In tray, small stores.

^{*} Per section. † For each ammunition wagon carrying a spare No. 18 pole.

‡ Per battery, carried in A, sub-section.

§ When limbers are fitted with new pattern hooks.

(a) Per battery, carried in F, sub-section.

(b) Per sub-section.

‡‡ 4 per battery.

(c) When existing bushes become unserviceable they will be considered obsolete

LIST OF STORES-continued. Ammunition Wagons-continued.

Articles.	No.	Where carried.
Ordnance-		
Bush, firing hole (spare)	1+	In tray, small stores.
Pole, draught, No. 18 (spare)	1	Under perch.
Rope, picketing, 66-ft	1	On platform board.
Saws, hand, 26-in	2	In cases, saw, hand.
Spanner, No. 93	1(b)	In case, side of ammunition box
Spanner, No. 267	1(a)	
Spindle, catch, limber hooks, No. 2	` '	
(spare)	1*1	In tray, small stores.
Spring, catch, limber and perch hook		l
(spare)	1‡	In tray, small stores.
Spring, spiral (clock type), range gear.	•	
Q.F. 13 and 18-pr (spare)	1*	In tray, small stores.
Valise, horse shoe	1(c)	Front of ammunition box.
Valises, tools, shoeing, wheelers or	` '	
saddlers	(c)	Front of ammunition box.

^{*} Per section.

† Per battery, carried in "A" sub-section.

† When limbers are fitted with new pattern hooks.

(a) Per battery, carried in F, sub-section.

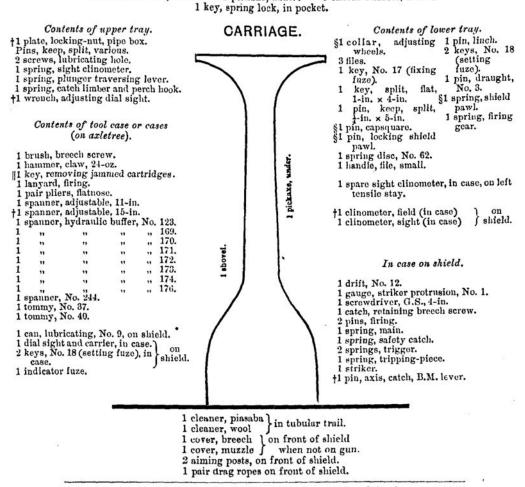
(b) Per sub-section.

(c) See footnote, page 40.

CARRIAGE AND LIMBER.

LIMBER.

On platform board. 1 bar, supporting pole. 1 line, Hambro'. 1 felling axe. 1 pair traces, saddlery. 2 straps, trace. 1 breastpiece. 2 straps, supporting front. 1 strap, supporting rear. 1 shovel. 2 tugs, trace. 1 swingletree. 1 crow-bar, 4-ft. 1-in. 1 drag washer } in box. 1 handle, air pump. 1 can, lubricating, No. 3 (mineral oil) under.
1 can, lubricating, No. 3 (Rangoon oil) under. 1 box grease, 3-lb., under. 1 billhook, under. 1 water brush, under. Fittings for 2 rifles on front of box. On top. 2 blankets. key, No. 18 (setting fuze).* (setting Upper tray carrier, ammunition. No. 18 12 rounds. Lower tray 12 rounds. On top at rear. Sponge Cloths. taining Syringe. air pump. 6 canvas buckets, under. 1 pickaxe, under. 6 canvas buckets, under.



When the guns are parked, the fuze keys should be placed in the tray of the ammunition box.

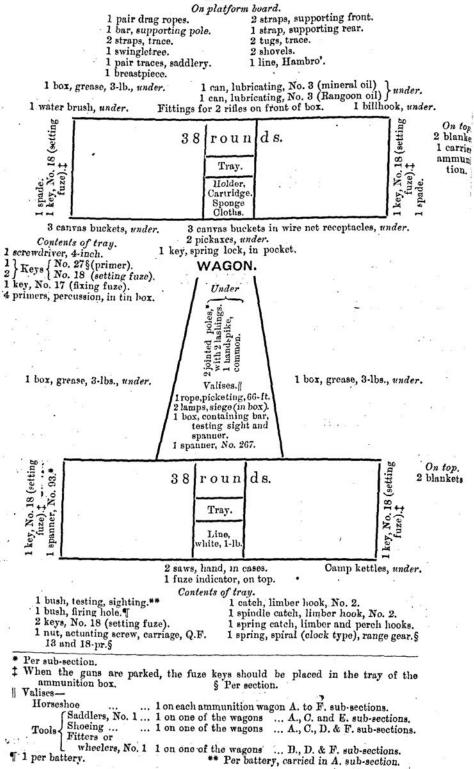
1 per section.

\$ 1 per battery in A. sub-section.

^{† 1} per section.

WAGON AND LIMBER.

LIMBER.



PART V.

CARE AND PRESERVATION.

GUN AND FITTINGS.

The breech fittings and also the guides on the jacket by means of which the gun slides in the cradle of the carriage, should be kept clean, oiled or greased and maintained in good working order; all working surfaces must be well lubricated, the fittings being taken off sometimes for this purpose, especially after firing.

Lubricating holes are prepared in the upper side of the carrier to admit of the rear end of the breech screw in the carrier being oiled. The holes are closed against the ingress of dust by means of a brass plunger and spiral spring which must be pressed down by the spout of the oil can when lubricating.

The breech should be kept covered up, when possible, to prevent dust and grit from getting into the interstices of the breech fittings, which might impede their easy working. A waterproof canvas cover is provided for the purpose.

A gauge, testing clinometer plane and axis of bore is provided for

use of Inspecting Officers.

For description and use of gauge, see "Regulations for Army

Ordnance Services, Part II."

A "gauge, plug, bore, low limit," for provisional condemnation is provided for use of Inspecting Officers, to save time and to avoid unnecessary measurements.

The gauge consists of a cast-iron cylinder having a handle formed at one end to facilitate insertion into the bore. A hole is made through the handle for the attachment of a line for pulling the gauge through the bore.

CARRIAGES, &c.

Hydraulic Buffer and Recuperator. .

To charge the recoil system.—This operation may be performed either (a) with the recoil unit assembled in position on the carriage, or (b) with the recoil unit assembled off the carriage.

In each case the operation should be carried out in the following

equence :-

- (A) Prepare the recuperator with liquid.(B) Charge the recuperator with air.
- (C) Fill the buffer system with liquid.

(a) RECOIL UNIT ASSEMBLED IN POSITION ON THE CARRIAGE.

A .- To prepare the recuperator (liquid).

(1) The gun may be dismounted, or lashed securely to the

cradle, in the run-out position.

(2) See that the piston-rods are correctly secured to the front cap; in particular, that the screwed collar is in position on the recuperator piston-rod.

(3) Remove plugs "K" and "L" and fully open valve "M."

(4) Pump or pour in through filling hole "K" EXACTLY 8-PINTS of liquid.

(5) Replace plugs "K" and "L."

(6) Elevate and depress the gun a few degrees several times.

See that gun still remains in the run-out position.

(7) LAY THE GUN HORIZONTAL BY A CLINOMETER BOTH LONGITU-DINALLY AND TRANSVERSELY. THE GUN MUST BE IN THE FULLY RUN-OUT POSITION.

This is most important.

(8) Remove plugs "K" and "L" and see valve "M" is fully open.

(9) Allow surplus liquid, if any, to flow from "L." If none flows,

pour liquid in at "K" until it does flow from "L."

(10) When flow of liquid from "L" has ceased, close valve "M and replace plugs "K" and "L," observing that washers are in position on the plugs.

(11) The correct amount of liquid required is 8-pints.

THE GREATEST CARE MUST BE TAKEN TO SEE THAT THE RECUPERATOR CONTAINS THE CORRECT AMOUNT OF LIQUID.

If the system contains too much liquid, firing the gun may cause

serious damage and even put the equipment out of action.

If the system contains too little liquid, leakage of air may result and the gun fail to return to the run-out position.

B.—To charge the recuperator (air).

(1) See that the recuperator has been correctly charged with liquid, as above.

(2) Remove plug "L" and connect up the pump-pipe adapter to

filling hole "L," gauge and pump hose.

- (3) DEPRESS THE GUN SLIGHTLY to avoid losing liquid when valve "M" is opened.
 - (4) Fix pump to trail and connect up hose leading to adapter.
- (5) Open valve "M" and pump air until the pressure gauge reads 700-lbs. per square inch.
 - (6) Air must not be pumped when reading the gauge.

(7) Check to see that gun is in the run-out position.(8) Close valve "M," disconnect pump, gauge and adapter.

Replace plug "L" with washer.

(9) Unlash gun and elevate to maximum elevation to ensure that the gun is retained in the run-out position.

C .- To fill the buffer system with liquid.

(1) See that recuperator has been charged and tested as in A and B above.

(2) Place the gun at 10 degrees elevation.

(3) Remove air-hole plug "N" and filling-hole plug "O."

(4) Pour in liquid at the filling hole "O" until it overflows at the air hole "N."

(5) Replace the air plug "N."

(6) Continue pouring liquid until it overflows at filling hole "O."

(7) Replace plug "O.".

(8) Quantity of liquid required, about 5-pints.

(b) RECOIL UNIT ASSEMBLED OFF THE CARRIAGE.

The procedure adopted is the same, practically, as when carried out on the carriage. The following points, however, are emphasised:—

(1) The necessity of having the cylinder block perfectly horizontal when preparing the recuperator with liquid.

(2) The recuperator piston must be fitted with collar and placed in the FULLY RUN-OUT position.

(3) The buffer piston-rod must be in the run-out position.

TESTS.

When some time has elapsed since the system was charged, or when the equipment has been travelled, the following tests should be made before firing takes place.

Instructions for ascertaining the amount of liquid in the recuperator

system :-

(1) Remove plug "L."

(2) Set range scale at zero.

(3) Set the gun horizontal lengthwise and crosswise by means of a field elinometer on elinometer plane.

(4) Slowly open the valve "M"; if oil spray issues, the liquid level is correct.

(5) If air only, shut valve "M."

(6) Elevate the gun successively to angles of 45', 1° 20', 1° 40' and 2° 30', repeating (4) and (5).

Note the angle of elevation at which oil spray issues on valve "M" being opened.

The amount of liquid lost is derived from the following table:-

170	Elevation at					
Liquid lost.		oil spray issues.				
1 pint		45'				
2 pints		1° 20'				
3 pints		1° 40′				
4 pints		2° 30′				

Note.—The gun should not be fired with a greater loss of liquid

than 2-pints.

To test air pressure.—See that stop valve "M" is closed. Remove the adapter-hole plug "L," screw in the adapter, blanking its outer end with a cap.

Screw the pressure gauge into the top of the adapter, open valve "M," when gauge should register 700-lbs. per square inch. If it does not, valve "M" should be closed, the pump connected to the adapter, and the air pressure in the pipe raised to the correct amount before valve "M" is again opened and pressure in cylinder raised to 700-lbs.

Liquid in buffer system.—The only satisfactory test for the buffer is to carry out the procedure as laid down for filling the buffer,

page 43.

LIQUIDS.

The liquid employed for buffer and recuperator is the Service

buffer oil, which MUST BE USED when available.

Care should be taken to see that it is clean and free from grit before putting it into the recoil system; this can be done by decanting and straining. Dirty liquid may cause serious damage to the working parts.

Alternative liquids which may be used in buffers and recuperators

in case of emergency :-

(1) Pure glycerine or a mixture of equal parts of glycerine and water.

(2) Any heavy lubricating oil.

(3) Soapy water or water containing a proportion of soda.

(4) Clear water may be used in a great emergency only, but it should on no account be allowed to remain in the cylinder for longer than is absolutely necessary, on account of its rusting action.

Kerosene, paraffin, or similar burning oils, must on no account be used for this purpose.

TO EMPTY THE SYSTEM.

This operation is not to be carried out in the open, but must be performed in dust-proof buildings, so as to reduce the chances of grit getting into the system.

It may be carried out with the recoil unit in position on the carriage, or the unit may be removed from the equipment. The

latter must be considered the normal method.

In this case the procedure to be adopted is as follows:-

(1) Place the recoil unit so that the rear portion is at a slightly higher level.

(2) Remove plug "L," open valve "M," and leave until all air

pressure has been exhausted.

- (3) Take off front cap and remove screwed collar from recuper-

ator piston rod.

(4) Remove stuffing box, packing and retarding valve from front end of recuperator and allow liquid to run off into a convenient receptacle, raising and lowering the front of the unit to drain the recuperator.

(5) Remove filling-hole plug "O" and stuffing box, with packing, from front of buffer cylinder, and allow liquid from buffer to run off into a receptacle, raising and lowering the front of the unit to drain the reservoir and buffer.

Should the unit be retained on the carriage the gun must first be dismounted, or securely lashed to the cradle, to prevent movement.

In all cases the liquid removed should be carefully examined for foreign substances, as valuable information concerning failures may be deduced from their nature.

TO REMOVE THE RECOIL SYSTEM UNIT.

To ensure that air recuperators are kept in good order, it is important that all adjustments or repairs to them should be carried out by skilled artificers working under dust-proof conditions. Consequently when a defect develops in a recuperator on service, no attempt should be made to repair it until the gun has been withdrawn from the firing line. Instead, the complete recoil unit and front cap should be removed from the cradle and replaced by a spare recoil unit.

To remove the recoil unit :-

(1) Depress the gun and lash it securely to the cradle.

(2) Disconnect the front cap from the casing.(3) Remove the nut securing gun to adapter.

(4) Withdraw the recoil unit to the front until adapter fouls cradle casing.

(5) Unscrew and remove the adapter.

(6) Remove the recoil unit with cap to front.

To replace the recoil unit:-

Reverse the above operations.

GLANDS AND PACKING.

Great care and attention is needed to ensure the correct and efficient functioning of the glands and packings of the recuperator piston-head and both piston-rods.

The object of these packings is to prevent leakage of liquid, consequently, when such leakage is observed an examination of the packings should be carried out and a remedy applied.

Liquid leakage from all three places shows itself by drippings at rear of the outer casing, rendering it difficult to determine which packing is at fault.

As it is forbidden to unpack or pack glands in situ, the only

remedy available is the tightening of the glands.

The operation of tightening glands must be carried out with discretion, as a gland which is too tight is just as likely to cause leakage as one which is too slack. Moreover, undue tightness in the gland is detrimental to the run-out of the gun and to the wear of the working parts.

If the leakage cannot be stopped, or kept within reasonable limits by judicious tightening, the whole recoil unit should be removed and

sent for repair, being replaced by a spare unit.

The glands therefore should be examined as often as opportunity permits and tightened if necessary. Such examination must be carried out before firing and if possible during pauses in action.

The gland packs better if screwed up when packings are hot from

firing, that is, during pauses in or after action.

When tightening up a packing ring the gland should not be

screwed home, metal to metal, in the stuffing box.

To tighten the piston-rod glands.—Insert a tommy through the slot in the front cap into the gland and tighten up the latter as necessary.

To tighten the packing on recuperator piston :-

- (1) Disconnect gun from cradle and withdraw about 12-inches, taking care that the cradle is slightly depressed.
- (2) Remove the adapter from rear of cylinder block.
- (3) Tighten the securing nut of the packing on piston, as is necessary.
- (4) Connect up adapter, push gun forward and nut up.

GENERAL REMARKS

Care and preservation by Battery personnel.—Before proceeding by march route it should be seen that the recoil system has been correctly filled, that the recoil unit is firmly secured to gun and pistonrods to front cap; also that there is no leakage at the gland, that the recoil regulating gear is in correct adjustment, and the plugs "K," "L," "N," and "O" have washers and are properly screwed home.

During a halt, a rapid survey of the recoil arrangements should

be made, to ascertain that all is in order.

When ordered to prepare for action the glands and packings should be examined for signs of leakage, and if necessary tightened. Care should be taken that the gun is properly connected up and that all securing nuts are fully home, with keep pins in position. The recuperator system should be tested for liquid level and air pressure. If necessary it should be re-charged. The buffer must then be filled, as there is no other satisfactory way of ascertaining how much liquid it contains.

During action, the functioning of the system should be carefully

watched and steps taken to apply remedies at once.

The following are the more common faults:-

Fault.	Cause.	Remedy.
Gun recoils violently or excessively.	buffer cylinder	Refill with liquid.
	Wear of piston and valve	Re-adjust correcting gear.
	Faulty packing	Tighten gland.
	Loss of pressure	as necessary.
Gun runs out slowly	Plug adjusting run-out too tight	Open plug slightly.
	Tight packing	Loosen packings.
	Loss of liquid in recuper-	1
9.€3	ator	Re-charge.
	Loss of air pressure	
Gun runs out violently	Plug adjusting run-out too open	
	Retarding valve off seat- ing	cause, after a few rounds
	Too much air prassure	change recoil unit.
Gun fails to run out	Too much air pressure Insufficient air pressure	lest and adjust.
dui fatts to full out	Loss of liquid in recuper-	Test and re-charge.
4	Too much oil in buffer	Loosen plug "N"
	Air in buffer	Work relief valve.
		Open plug slightly.
		Loosen.

Relief valve.—Should the gun not run out fully to the front after firing, due to air in the oil reservoir, depress the gun, insert the finger through the hole in the case, and push the valve to the front off its seating which will allow the air to escape and the gun to move up into the run-out position.

The gun should be carefully watched during recoil; should the black line marked on the gun be visible at the rear of the cradle, the buffer must be examined as soon as possible. Should the red line become visible at the rear of the cradle, firing must cease. If oil is being lost from the buffer and recoil become excessive, the packing ring must be either renewed or adjusted. After this operation the buffer should be refilled.

Should the ordinary outside adjustments as specified above fail to give satisfactory results, the recoil unit should be removed and replaced by a spare one which may be charged before insertion in

the cradle.

During severe weather buffers and recuperators should be protected as much as possible from the cold in order to prevent the liquid contents from becoming frozen. They may be covered with sandbags, sacking or straw, and if in gun pits the use of braziers or stoves is most beneficial.

Service buffer oil should remain unfrozen down to a temperature

of 0° F.

Should the liquid become frozen, firing must not take place; instead, the recoil unit should be removed and replaced by a spare one. The liquid in the former should be thawed.

To ascertain if the liquid in the system is frozen, proceed in a similar manner to that laid down for testing liquid level on page 43.

GENERAL INSTRUCTIONS.

Elevating gear.—In replacing the bearings and elevating nuts, care must be taken that the open side of the bearing is inserted first in the upper gear and the closed side first in the lower gear (with the teeth of the elevating nuts at the top in both cases), so as to ensure that the gun is always elevated by revolving the handwheels towards the rear, or depressed by revolving the handwheels towards the front.

Range indicator.—The yard and degree scale should be kept perfectly clean, free from grit, burrs or dents and the revolving surfaces

slightly greased.

In replacing the eccentric bush in the arc guides, care must be taken that the bush is placed in such a position as to ensure the least possible play between the teeth of the pinion and the elevating arc. The grooves in the eccentric bush which engage the stop pin are arranged to give eight adjustments, which are numbered 1 to 8, Nos. 1 and 8 representing the minimum and maximum setting respectively.

A certain number of bushes have the grooves numbered 1 to 8, but Nos. 1 and 5 indicate the minimum and maximum setting

respectively.

The order of adjustment for each pattern bush is as follows:-

					Nos. 1 and 8. Minimum and Maximum.	Nos. 1 and 5. Minimum and Maximum.
st ad	justment	 			 1	1
2nd	•	 •••			 2	2
Brd	,,		•••		 3	8
th	"	 	•••	•••	 4	3
th		 			 5	7
th	11	 			 6	4
th	"	•••	•••		 7	6
th	"	 	•••	•••	 8	5

To exchange a damaged clock spring.—Run the cradle right down to full elevation. Remove the cap covering the left end of the spindle of the range indicator.

Throw the reader back clear and remove the jamming plate, yard scale ring, spring case and barrel with spring from off the spindle.

Push the spindle out a couple of inches to the left, so as to get

the pinion out of gear with the arc.

Remove the damaged spring from the casing, insert a new one, replace the barrel and case with spring on the spindle, fitting the

barrel on its bearing on the cradle.

Revolve the spring case to the front by hand as far as it will go, thus winding up the spring, slack back a quarter of a turn, hold the spring case firmly and push the pinion through into gear with the arc.

Replace the cap, yard ring and jamming plate and adjust the yard

scale ring to the horizontal plane of the gun.

Brake gcar.—When the brake is applied, the releasing lever must be housed, as at (F) (Plate XI).

Any wear in the eccentric can be adjusted by screwing up the connecting bolt of the link eccentric.

When assembling the "Lever, releasing brake," the hexagon on the spindle portion of the lever must be placed in the eccentric so as to give the maximum amount of throw.

Traversing gear.—The pivot of the crosshead (B) (Plate IX) should be kept properly nutted up and any lateral play in the traversing screw adjusted by tightening the crosshead cap (C) and the check nut (D).

Clamping gear for carriage body.—This clamp should always be on when travelling. To put on the clamp the lever is pulled to the rear, which tightens the nut and draws the carriage down to the trail, thus making it difficult to turn the traversing handwheel.

If, owing to wear, the lever cannot be moved sufficiently to tighten the clamp properly, it must be moved to another position on the octagonal nut.

In action the lever must be pushed as far forward as possible.

Gear, clamping cradle.—Care should be taken that the handle of the clutch spindle is always against the stops when not in use.

The cradle can only be clamped when the gun is at extreme elevation. The gear is intended for use when travelling only.

In replacing the clamping gear the clutches (which are left and right) must be correctly placed on the spindle, i.e., the thinnest portion of the eccentric being to the front and both in the same relative positions on the spindle, so as to engage the bearing on the cradle at the same time.

Pin, locking shield pawl.—It should be carefully noted that this

pin is always in proper position when travelling.

Wheels, Nos. 43 and 45.—These wheels are fitted with dust caps, which can be removed with a No. 93 spanner; lateral play between end of pipe box and linch pin can be adjusted by means of an adjusting collar with slots, through which the linch pins pass; the slots vary in depth from 0.2-in. to 0.5-in.; the difference in depth between each slot allows for a wear of 0.05-in.

A linch pin of a capped wheel with the adjusting collar can be

used with any ordinary second class wheel, if required.

An ordinary second class linch pin and a second class "C" drag washer can be used on an emergency, with a capped wheel, if the cap be removed.

Sights.—Great care must be taken not to damage the sights when removing or replacing. The parts of the carriage to which the sights

are attached must be absolutely clean and free from burrs.

Deflection screw and nut.—Should be kept free from grit and dirt and should be well greased and if removed for any purpose care should be taken in replacing that the spring which is within the nut (the latter being in halves) is properly compressed before entering the screw. The spring fitted in the deflection nut, to obviate backlash, may be found stronger than is necessary for its work, the result being stiffening and increased wear on the screw. The spring should require a weight of 5 to 7-lbs. to compress it to 0.9-in. The Armament Artificer will test the spring and shorten it if found necessary.

Adjusting bush.—This should be kept clean and well oiled and if removed for any purpose, steps should be taken to have the sight

adjusted to the vertical plane of the gun.

Yard scale ring.—This should be kept clean and oiled and if removed for any purpose, on replacing it should be set to the horizontal plane of the gun and sight.

Clinometer sight.—Should be kept oiled and free from grit and in

perfect adjustment.

Capsquares.—To remove cradle capsquares for cleaning &c., the carriage body must be traversed as far as it will go to the left to admit the right capsquare key being removed, and to the right to remove the left key.

"SIGHT, DIAL, No. 7."

The dial sight when issued from Woolwich is in correct adjustment, watertight and with all the cells and joints secured with fixing screws.

It is very unlikely that the interior will require to be cleaned, and the dial sight must on no account be taken to pieces, except by persons holding a certificate from the Artillery College stating that they are qualified to do so.

The body of the dial sight must be cleaned with a clean soft cloth and a little oil, which must be rubbed off afterwards, care being taken that the glass is not touched.

The exterior of eyelens and window should be cleaned with chamois leather, specially kept for the purpose, and only by a competent person. Great care must be taken that no oil or grease is allowed to touch the glasses. Fingers when apparently clean and dry may leave marks on the lens which will impair the definition of the telescope.

Dermatine or rubber eye-guards should not be unnecessarily exposed to extremes of temperature, to the sun's rays or to bright light.

Oil and grease will inevitably destroy rubber or dermatine, and prolonged contact with benzol, petrol and chemicals is undesirable. If, however, oil or grease gets on the eye-guard it should be immediately removed, either—

- (a) by wiping with a clean rag soaked in benzol or petrol;
- (b) by washing in water to which a little soap and soda have been added.
- (c) by wiping off with a clean dry rag.

Spare eye-guards should be stored in a box completely filled with French chalk (so as to exclude air). The eye-guards should be packed in such a way that they are not distorted. If French chalk is not available the eye-guards should be kept under water.

If, after being in store for some time, the eye-guards lose their pliability, they can generally be rendered supple when required for use by steeping them in warm water.

LIMBER AND WAGON.

Lids, wagon limber.—In opening and closing the lids of this limber the centre lid must be opened first and closed last.

In order to prevent the wickerwork of the baskets from deterioration from wet (due to condensation), resulting possibly in damage to the ammunition, the lids of the limbers and wagons should be left open in dry weather daily to thoroughly dry the interior. Care is to be taken, however, that dust is excluded as far as practicable. Felt joints are to be kept in good order to exclude water from the interior of the boxes.

LIST OF LUBRICATING HOLES.

Fittings which are provided with oil holes for lubricating purposes.	No. of Holes.	Position of Holes.
CARRIAGE.		
Capsquares (2) each	1	
Bearings, axletree (2) "	1	In lubricating cup, 1 on each side.
" clutch spindle (2)	1	Inside carriage body, 1 on each side.
Cap, lower bracket of elevating gear	2	In bearing portion for handwheel spindle on left side.
Cradle—		P
Body	. 10	1 each side of keyway gun slide, 7 in sides for oiling sliding surfaces, and 1 on left side at rear, with tube for lubricating handwheel spindle.
Bearing, pinion, spindle handwheel Gear, brake—	1	On right side close to handwheel.
cranked levers (3), each	1	2 on left side and 1 on right
Bolts,		
connect-{ eccentric link	. 1	close to shield. In head of bolt, right side near brake
fork actuating screw	. 1	In head of bolt, left blocks.
Fork, actuating screw	1	On right side.
Ti-le accoutuie	. 1	On left side.
Dad semposting elevating sensor	1	In lower end.
A as machine	1	In upper end, left side.
	2	1 at each end, left side.
Bracket, connecting arc, range gear .	1	On left side.
Bolts, connecting brake arms (2) each		In head of each bolt.
T I	1	At jointed end of lever, near
Lever, traversing	1	plunger.
Recuperator, bottom guide	1	Lower position on case.
at 1 f	1	For oiling arm trunnion support ing sight.
Wheels, 2nd Class, "C," No. 45 (2) eac	h 1	In inner flange.
WAGON, AMMUNITION.		
Levers, cranked, brake gear { near off		Rear of wagon.

Note.—In order to assist in identifying the position of the lubricating holes, the heads of the screws should be kept free from paint.

PART VI.

MISCELLANEOUS STORES.

Apparatus, illuminating aiming point.—The apparatus consists of the following principal parts:-

> Box, battery. Post, ground. Box, lamp with reflector.

The battery box is made of tinned sheet iron japanned black and prepared internally to receive 3 batteries, dry, "Y," panel switch with emergency link, base plate with insulating plate and ratchet switch, which is operated by means of a Bowden wire with swivel passed through an opening formed in the box and provided with a removable phosphor bronze spring. A compartment is also provided to hold spare parts, tools, &c. The box is fitted externally with two clamps for securing it to the ground post.

The post, ground, is made of tubular iron, 13-inch in diameter and about 3-ft. 3-inches long, having a steel point at one end for insertion in the ground and a steel plug at the other. One end of a steel spiral spring is attached to the post by means of a ring and to the other is attached the swivel of the Bowden wire referred

to above.

The box, lamp with reflector is a tinned sheet iron box japanned black, fitted internally with a 3.5-volt lamp held in a socket secured in an ebonite base to which is fitted a semi-circular trough-shaped reflector. Attached to terminals on rear of ebonite base is one end of a two-way cord conductor, 30-ft. in length, the other end being provided with a two-pin plug. A glass strip 31-inches long is fitted into an aperture in the middle of the lid. The top rear of the box is provided with a loop for attachment to the aiming post.

Instructions for use and diagram of circuit are attached on the

inside of the lid of the battery box.

When not in use, the whole of the apparatus, with the exception of the ground post, is contained in the battery box.

A waterproof cover for protection of battery box is provided.

Bar, testing rocking-bar sight, Q.F. 13 and 18-pr.—The bar which is for use in testing the sights, as detailed on page 29, is of cast steel; it is 30.75-inches in length, having a countersunk hole in the front-end to fit over the acorn portion of the foresight, the rear-end being provided with a hinged bracket to clip over the sides of the leaf of the hindsight so as to prevent the bar from falling off. A clinometer plane 7-inches in length is formed on the rear-end of the bar, on which is placed a field clinometer when carrying out the tests.

When not required for use the bar is contained in a wood box

designed for the purpose.

Box, charging pumps.—The Mark II box, which is made of wood, is strengthened by steel angle plates and has, secured to the bottom, two wood strips to seat the box on the limber.

The lid is covered with canvas and is provided with two steel hinges. It is fastened by means of a steel turnbuckle and hasp.

Leather loops† with buckles are provided on the back of the box for housing the handle of the air pump and at each end for carrying purposes or for securing the box to the limber.

The box is provided with a tray and suitable internal fittings to carry one air and two liquid pumps, five adapters,† flexible hose and

pressure gauge No. 5, together with spare parts and tools. The approximate overall dimensions are:—

Cleaner, piasaba, No. 18.—The cleaner consists of a brush composed of piasaba or kittool bristles fixed on the middle portion of a 1-inch white hemp rope lanyard. A 1.5-inch diameter lead ball is attached to one end of the lanyard so as to carry it through the bore of the gun. Total length of lanyard is approximately 220-inches.

Cleaner, wool, No. 1.—The wool cleaner is generally similar to the piasaba cleaner described above, from which it differs principally in having a wool sponge fixed in the middle portion of the lanyard

instead of a brush.

Clip, cartridge, No. 4.—The clip is made of brass, cross-shaped so as to form four arms the ends of which are turned in to engage with the rim of the cartridge case. The clip protects the cap of the percussion primer. One arm is painted red and is slightly longer than the others, the clip portion being differently shaped so as to spring over the rim of the cartridge. One or two longitudinal ribs may be stamped on the long arm as an alternative. The other three arms may be tinned, copper plated, blackened in oil or galvanized. It has a webbing loop for withdrawing the cartridges from the baskets in the ammunition boxes of the limbers and wagons.

Cover, breech, No. 2.—The cover is made of waterproof canvas and formed to protect the breech mechanism of the gun and the rocking-bar sight; it is secured in position by lacing loops and quick release

straps.

Cover, front cap, recuperator case.—The cover, which is of service colour waterproof canvas, is cylindrical in shape and is formed with three openings to take the lugs on the front cap. It is secured when in position by a strap which passes through three leather loops fastened to the cover.

Cover, muzzle.—The cover is made of service colour waterproof canvas shaped to suit the muzzle of the gun; it is provided with a leather strap to secure it in position.

Drift, No. 12.—The drift is of steel and is for use in removing

keep pins from the mechanism.

Gauge, striker protrusion, No. 1.—The gauge is of steel plate and is for use in gauging the protrusion of firing pins or needles of strikers of Q.F. 6-in. to 12-pr. guns.

Implements, ammunition—Key No. 17, fixing Nos. 80 and 83 fuzes.—The Mark II key is made of steel, one end being shaped to fit over the fuze; the lower edge of the ring portion is bevelled

[†] In future the "Box, charging pumps" will be provided with two additional leather loops to carry the Mark II adapter pump pipe in its cover.

to suit all Marks of No. 80 fuzes without covers and is provided with a projection to fit the square notch in the flange of the fuze body. The upper edge of the ring is provided with a slot to fit over the projection on the cover when screwing in No. 80 fuzes with cover.

The Mark I key differs from the Mark II, the upper edge not being prepared for use with fuzes with cover.

Implements, ammunition—Key No. 18, setting Nos. 80 and 83 fuzes.—The Mark I key is for use when the lower time ring is too stiff to set by hand. It is made of steel and formed to engage with the pin projection of the lower time ring. It is provided with a loop of white line, 30-inches in length.

The Mark II key differs from the Mark I, the ring portion being of greater depth and thereby taking a better seating on the fuze.

Total length of key ... 6.17-inches.

Implements, ammunition—Key No. 27, primer 13 and 18-pr.—This key is for use in inserting or removing the percussion primer in the cartridge. It is made of steel and formed to engage with the two recesses in the head of the primer. It is also fitted with a white line lanyard.

Total length of key 13·1-inches.

Implements, ammunition—Key No. 32.—This key is alternative to the No. 17 Mark II key, to which it is similar except that it is double-handled, and instead of the projection for fixing the earlier marks of fuzes being formed solid in the key it is made separately of hardened steel wedge-shaped and driven into the key. It is heavier and stronger than the No. 17.

Implements, ammunition—Key No. 53.—2-inch percussion fuzes. This key is for use in lieu of the No. 16 key, with 2-inch percussion fuzes and for "Adapter, 2-inch fuze hole No. 2." Each end is semi-circular in shape with the inner end chamfered and a projection formed to engage in the slot for the purpose.

Implements, ammunition—Key No. 59.—This key is for use in removing G.S. fuze hole plugs, also for G.S. special and 2-inch fuze hole plugs, except 2-inch No. 3 Marks IV and V and No. 8.

It is made of steel. It is double-handled, and consists of a 15-inch round bar passing through a centre portion, having a circular base recessed to fit over the plugs, a projecting rib being formed across the centre of the recess to engage in the key slots on the top of the plugs.

A slightly tapered square projection is formed on the top of the centre portion for use with plugs having square recesses.

Implements, ammunition—Key No. 73.—Fixing T. & P. No. 80, Mark XI and Time No. 180, Marks X and XI fuzes with or without cover. The key is double-handled and shaped at the centre to fit over the fuze; a square recess is cut in the ring portion to receive the stud on the fuze body.

Indicator, fuze, Mark III. (Plate XXII).—This indicator is of delta metal, graduated, with clamping handle and plate with two

screws, reader with spring and tension screw and two stop screws; it is fitted with a reversible slide for Nos. 80 and 85 fuzes and a movable M.V. corrector scale.

The base plate is about 34½-inches long, graduated on the upper portion with a yard scale, the lower portion being fitted with a movable M.V. corrector scale; it is grooved in the centre to receive the slide which is reversible and graduated with a fuze scale.

The corrector which is of brass is graduated on the upper edge with the fuze corrector and on the lower edge with two M.V. scales, one for carriages fitted with M.V. correcting gear and the other for carriages not so fitted; it is provided with a slot towards each end and is secured on the indicator by two cheesehead screws on which the corrector is able to slide. An index plate is provided and it is secured to the under side of the indicator.

The *slide* can be secured in any position desired by means of the clamp which is attached to the base plate. The yard and fuze scales are read by the reader, which is free to move along the base plate, but it is prevented from coming off the base plate by stops. Attached to the reader is a small spring which can be manipulated by a screw for taking up any play in the reader due to wear.

Two indicators per sub-section will be carried, one on the shield of the carriage and one on the ammunition wagon at the rear.

Key, removing jammed cartridge case.—This key is for use in removing cartridge cases which have jammed after firing. It consists of a steel rod, one end of which is formed into a key to fit the key-holes in the primer and the other end has screwed and riveted to it a metal plug of the same dimensions as the percussion primer, the bush being screw-threaded to fit the primer hole in the cartridge case. A cross handle is formed about the centre of the rod for hauling purposes.

Lanyard, firing, No. 15, Mark II.—The firing lanyard is of steel wire rope 10-feet in length with a steel hook on one end shaped to suit the trigger of Q.F. 18-pr. and 13-pr. guns. A steel toggle is attached to the other end of the lanyard.

The Mark I differs from the Mark II, being made of tarred white line, and it has a wooden toggle (see Plate XXIII).

Pin, firing, dummy and screw, breech, dummy.—The abovementioned fittings are provided for drill and instructional purposes and are intended to prevent wear to the service mechanism and breech opening of gun.

The dummy firing pin differs from the service pin in not having

the portion which projects through the firing hole bush.

The body of the original Mark I dummy breech screw is of wood, having front and rear bronze plates and a copper alloy ring with screw thread, which engages the screw threads in the breech opening of the gun. The rear plate is arranged to fit the carrier and is provided with bevel teeth corresponding with those on the breech mechanism lever. The interior of the breech screw is recessed for the reception of the service striker with firing pin removed and dummy firing pin substituted. The interior of the front plate is fitted with a rubber pad to take the blow of the dummy firing pin when the trigger is pulled; this pad, when worn out, will not be replaced.

Dummy breech screws of later manufacture have the outer face of the front bronze plate made similar in shape to the front end of the service breech screw, but slightly larger in diameter, so as to work the extractor in the gun. Such dummy breech screws are described as Mark II. Existing Mark I screws altered to conform to the Mark II pattern are known as Mark I*.

In future manufacture dummy breech screws will differ from Mark II, being entirely of bronze, cast to shape, and having a vulcanized fibre pad in the front-end of the striker and dummy firing pin. Such dummy breech screws will be described as Mark III.

In the case of Q.F. 18-pr. guns using Mark I dummy breech screws, if the drill cartridge case is not used for loading on account of grit, &c., getting on the breech screw, the extractor should be removed from the gun.

Pump, air, two-stage, horizontal, No. 2, Mark I. (Plate XXIV).—
The pump which is for use in charging the recuperator system with air is when required for use secured in position to a saddle fixed on the top of the trail (see page 12) and is rapidly secured therein by placing it at right angles to the trail and turning it through an angle of 90-degrees and locking it with clamps (10) dropped over the pins (12). The rocking lever (8) is dropped over the pump into position on the saddle, care being taken that the milled faces on the ends of the gudgeon pin (5) slide into the slots of the lever.

The pins (13) must be pulled outwards before lowering the lever. When the pins (13) are opposite the fulcrum holes in the saddle they are then pushed home.

The keep-plugs (24) are provided to hold these pins in their proper position.

When the tubular handle is inserted and the delivery pipe connected to the hose connection (16) the pump is ready for operation.

Instructions for working pump.—Before starting up, oil all wearing surfaces, such as the gudgeon where it passes through the piston, the sides of the rocking lever which engage on the flats of the gudgeon pin and the pins (13) working in the saddle. Remove the inlet strainer cap (18) and feed a few drops of oil into the suction inlet, remove hose connection cap (17), connect the delivery pipe to the hose connection (16) and to the recuperator connection, insert the tubular handle and the pump is ready for operating.

In operating this pump it is essential that the handle should move through the full arc of movement, i.e., the rocking lever (8) should touch the stops (27) on each stroke, otherwise the stroke, not being completely finished, the best results will not be obtained from the pump.

Plate XXIV shows the pump in section in two views, and it will be observed that all valve springs and valve plugs are interchangeable.

Should the air delivered from the pump fall off, remove valve plugs and examine valves and seats to see that there is no dirt in the system, as this is generally the cause of loss of air. The inlet strainer cap (18) and the hose connection cap (17) should always be replaced immediately pumping is finished to ensure that no dirt gets into the pump.

To examine the piston and cylinders, remove the low-pressure and high-pressure covers (3 and 4 respectively) and withdraw gudgeon pin (5), when the piston can be withdrawn endways out of the pump.

When not in use the pump should be kept in the "Box, charging pumps."

Pump, liquid, portable, No. 2.—The pump is used to charge the recuperator with liquid. It consists of a brass barrel, barrel cover, base, plunger, delivery and suction hose.

The barrel, which is cylindrical, is fitted externally with steel gills extending throughout its length for protecting it from injury. The upper end of the barrel is prepared to receive a screwed cover, which is bored for the passage of the plunger rod, and the lower end a base, consisting of a brass socket in which ball valves and springs for suction and delivery are held in position by screwed plugs and two feet.

The plunger consists of a steel rod provided with two leather cupshaped packing rings at its lower end to fit the barrel, and a wood cross-handle attached to the upper end; the packing rings are held in position by washers, spiral spring and nut.

Two malleable iron feet are attached to the base socket for steadying the pump when in use and two connections are also formed on the base socket for the attachment of the suction and delivery hose.

The delivery and suction hose are made of flexible metallic tubing and provided with a brass union and sleeve; the suction hose is further provided with a strainer. The delivery hose is 1-inch by 6-feet long and the suction hose 3-inch by 5-feet long.

When not in use the pump should be kept in the "Box, charging pumps."

Range correction scale. - A Mark II range correction scale is issued for use with range dials graduated in yards for a M.V. of 1615-f.s. and consists of an ivorine body to which is pivoted a transparent celluloid plate. The scale is carried in a stiff cardboard

Scales representing map range, increase and decrease of range and air temperature are engraved on the body.

The map range is graduated in multiples of 500-yards from 0 to

8,000-yards, and figured at every 1,000-yards.

The increase and decrease of range scales are graduated in multiples of 25-yards from 0 to 500, and figured at every 100-yards.

The air temperature scale reads from 20 to 100 degrees in multiples of 5 degrees.

Scales representing wind velocity and barometer readings are

engraved on the celluloid plate.

The wind velocity scale is graduated in multiples of 10 and reads

from 0 to 50-feet per second with or against the wind.

The correction scale is for use with all charges, and from it can be calculated the correction required for any variation from the normal of conditions affecting external ballistics; the correction for any variation affecting internal ballistics must be calculated and applied separately.

To use the scale. — Ascertain the temperature and barometer readings. Set these readings to coincide on the scale. The amount of correction is then read off the ivorine body by means of the wind scale curves.

Rimer, breech screw, Q.F. 13 and 18-pr.—The rimer is of steel and consists of a cutter with holder, sleeve and guide block. It is for use in removing burrs from the striker recess in the breech screw.

Setter, fuze, hand, Q.F. 18-pr., Mark I.—The setter, which is for use with No. 80 type of fuzes fitted with stud and slot, consists of a graduated ring with setting ring, screwed on to a locking ring with steadying legs and a graduated plate. The graduated ring has vertical graduations round the edge to correspond with those on the fuze, filled in with white wax, and has a safety mark filled in with red wax. Two handles are formed on the side and holes are tapped on the top to receive the screws for securing the graduated plate, also a hole to receive a screw with finger piece for the locking device, on either side of which are two pins to limit its travel.

The locking ring is screwed into the underside of the graduated ring and has three steadying legs with adjusting screws, one of the legs being fitted with a spring plunger to engage in the slot in the flange of the fuze.

The setting ring, which is secured between the graduated ring and the locking ring, is shaped internally to the contour of the fuze time rings and has a slot cut in the bottom inner edge to receive the stud on the setting ring of the fuze; a brass indicator is screwed on the top face.

The graduated plate is secured by three screws in a recess in the top of the graduated ring and has graduations on one side corresponding to those on the fuze, a safety mark and the following words:—

"To be used with or without calibrating sights."

The safety mark is filled in with red wax and the other markings with white wax.

Earlier issues of the fuze setter had three plates which were marked with the muzzle velocity for which graduated, but the one now fitted is graduated for normal muzzle velocity (M.V. 1615-f.s.) and is not marked.

Instructions for use.—The amount of setting is determined by the angle which exists between the slot in the setting ring and the spring plunger in the steading leg of the locking ring.

To adjust this angle the "setting" ring is turned until the pointer (or indicator) is in exact register with the required fuze setting shown on the graduated plate and is clamped in position by a pressure of the finger-piece of the locking device.

The setter is then placed over the fuze and rotated until the slot in the base of the setting ring engages the stud on the time ring of the fuze, after which the rotary movement is continued, in either direction, until the spring plunger in the steadying leg engages in the slot in the flange of the fuze and prevents further movement. The fuze is then set.

"Care should be taken that during the rotary movement an even downward pressure is placed on the setter to prevent the slot in the setting ring disengaging from the stud on the fuze."

Note.—The marking on the outside of the fuze setter is placed there to enable a reading to be obtained at any time of the actual

setting given to the fuze by the fuze setter.

The Mark II fuze setter differs from Mark I, not being fitted with a separate graduated plate, the scale being engraved on the top surface of the graduated ring and vertical graduations round the side omitted.

The pointer (or indicator) on the setting ring is engraved instead of being made in metal and screwed on.

Tools, packing gland, Q.F. 18-pr.—Collar, Mark I., Plug, Mark I.— The collar and plug are for use in packing the stuffing-box of the hydraulic buffer.

The collar is for assisting the compressed ("Dicks") packing ring

over the shoulder of the piston rod.

The plug is for removing the packing and supporting rings and packing washers, from the stuffing-box.

Tool, withdrawing ring supporting packing, Q.F. 13 and 18-pr., Mark I.—The tools are for withdrawing the outer ring supporting

packing from the stuffing-box of the hydraulic buffer.

Wrench, breech mechanism, No. 77.—The wrench is of steel and is for use in removing or inserting the firing hole bush in the breech screw.

PART VII.

AMMUNITION.

		PROJECT	ILES.			Cartr	IDGES.		
Nature. Mark.		Burstin	ng Charge.	Approximate weight	Fuzes.	Nature of	•	Approximate weight for empty	Means of firing.
	(a)	Nature.	Weight.	filled and fuzed.		Charge.	Weight of Charge.	cartridge case with primer and clip.	
High Ex- plosive (stream- line).	I.C.	H.E.	lbs.ozs.drs 1 1 4	lbs, ozs, drs. 18 8 0	D.A. No. 115E or 115	Cordite M.D. or R.D.B., size 8 (full charge)	lbs.ozs.drs. 1 6 4	lbs. ozs. drs.	
High Ex- plosive	VII	H.E.	0 15 4	18 8 0	D.A. No. 106E or 106 or P. No. 101E with No. 2	Cordite M.D. or R.D.B., size 8 (full charge)	1 6 15	e 1	Primer
High Ex- plosive	VII	H.E.	0 15 4	18 8 0	gaine D.A. No. 106E or 106 or P. No. 101E with No. 2	Cordite, size 74 (full	1 4 0	3 9 8	perussion Q.F. cartridges,
High Ex- plosive	VII	H.E.	0 15 4	-	gaine D.A. No. 106E or 106	Cordite M.D. or R.D.B.	0 9 0		No. 1,
Shrapnel	XVII	Powder	0 1 12	18 8 0.	T. & P. No. 80	size 2½ (reduced charge) Cordite M.D. or R.D.B., size 8 (full charge)	1 6 15		

Shrapnel	XVII	Powder	0 1 12	18 8	3 ,0	T. & P. No. 80 Cordite, size $7\frac{3}{4}$ charge for India)	(full	1	4 0				Í
Shrapnel	xvII	Powder	0 1 12	18 8	3 0	T. & P. No. 80 Cordite, M.D. or I size 21 (reduced c	R.D.B., harge)	0	9 0				
Gas	VI	-	-	18 8	3 13	D.A. No. 106E or 106 Cordite, M.D. or I size 8 (full charge	R.D.B.,	1	6 15				Primer percussion
Gas	VI	-	-	18 8	8 13	D.A. No. 106E or 106 Cordite, size 74 charge for India)			4 0	11	3 9	8	Q.F.
Smoke	11	-	_	18 9	9 2	D.A. No. 106E or 106 or Cordite, M.D. or F P. No. 101E with No. 2 size 8 (full charge	R.D.B.,	1	6 15				No. 1.
-	- -	_	_	_	•	gaine Blank L.G Cordite M.D.T. or			0 0 8 12				
	. —		_		-	R.D.B.T., size 15/				1			

(a) Other marks may be met.

CARTRIDGE, Q.F. 18-PR., SHRAPNEL. (Typical for Full Charges.) (Plate XXV.)

The ammunition is fixed, and a complete round consists of a cartridge case, percussion primer, charge, shrapnel shell and fuze.

The case is made of solid drawn brass, slightly tapered towards the mouth, and has a hole in the base screwed and recessed to take a percussion primer; a rim is provided by means of which the extractor of the breech mechanism automatically ejects the empty case when the breech is opened.

The No. 1 percussion primer consists of a metal body screwed externally for a portion of its length to fit the primer hole in the cartridge case and contains a percussion cap and powder magazine.

(Plate XXVI.)

The charge consists of a 1-lb. $6\frac{15}{16}$ -oz. bundle of cordite M.D., or R.D.B., size 8, recessed at one end to fit over the primer and the boss of the case, the other end being in contact with the shell. The cordite sticks are secured in two places by shalloon braid.

The charge for India consists of 1-lb. 4-oz. of cordite, size 73, and differs from the above in the cordite being secured in three places

instead of two by shalloon braid.

The shrapnel shell has a steel body with a recess in the base to contain a tin cup for the bursting charge. The head of the shell is struck with a radius of two diameters and is fitted with a 2-inch metal fuze socket.

A brass tube conveys the flash of the fuze to the bursting charge, one end of the tube being fitted into a fuze socket, the other being

screwed into a steel disc placed over the tin cup.

The Mark XVII shell contains approximately 292-mixed metal bullets (41 per lb.) and is fitted with a copper driving band in a groove having two waved ribs. The number of bullets varies with the Mark of the shell.

The shell is secured in the case by the edge of the latter being pressed into the groove at the rear of the driving band.

The base of the cartridge case is unpainted.

Cartridge, Q.F. 18-pr., Shrapnel. (Typical for Reduced Charge.) (Plate XXVII.)

This cartridge is generally similar to the full charge; the reduced charge is 9-oz. of cordite, M.D. or R.D.B., size 2½. It consists of a cylindrical bundle of cordite sticks tied in seven places with double silk sewing, with two fins of cordite passed through the centre of the charge at right-angles to it near each end, to keep the charge central in the case.

A recess is formed in the base of the charge to fit over the boss in the bottom of the case and the plain portion of the percussion primer.

To distinguish shrapnel cartridges with reduced charges the shell from the shoulder to the driving band and the base of the cartridge case are painted white. As an alternative method of making up the charge the fins are omitted and a small ring of cordite sticks placed around the base of the charge.

CARTRIDGE, Q.F. 18-PR., H.E. (Typical for Full Charges.) (Plate XXVIII.)

This cartridge consists of a case with primer, charge, H.E. shell and fuze.

The case and primer are the same as described for the shrapnel cartridge.

The *charge* consists of 1-lb. $6\frac{15}{16}$ -oz. cordite M.D. or R.D.B. size 8, as described for the shrapnel cartridge.

The charge for India consists of 1-lb. 4-oz. of cordite, size 74, and

is similar to that described with shrapnel.

The H.E. shell consists of a forged steel body, the head of which is screwed internally to the 2-in. fuze-hole gauge for a depth of 1.2-ins.

Near the base of the shell a groove is turned, in which is fitted a copper driving band.

The shell is secured in the cartridge case by the edge of the latter being pressed into the groove of the driving band.

The base of the cartridge case is painted yellow.

CARTRIDGE, Q.F. 18-PR., H.E. (Typical for Reduced Charges.) (Plate XXIX.)

The M.D and R.D.B. reduced charges of 9-oz., size 21, each consist of a cylindrical core of 10.4-in. cordite sticks secured in two places with silk sewing, surrounded at the base by a ring of 4.1-in. sticks, tied in two places with silk sewing and so arranged as to fit over the boss of the case and protruding portion of the primer. The base of the cartridge is painted yellow with a white band across the centre. The shell is painted white from shoulder to driving band.

CARTRIDGE, Q.F. 18-PR., H.E., STREAM-LINE.

The Mark I cartridge consists of a case with primer, a charge of cordite M.D. or R.D.B. shell and fuze.

The case and primer are the same as described for shrapnel shell. The 1-lb. 64-oz. charge of cordite M.D. or R.D.B. consists of a cylindrical core of 8'4-inch cordite sticks tied in two places with silk or cotton sewing, surrounded by a ring of 9'1-inch sticks secured in three places with shalloon braid or white tape, and so arranged that a recess is formed at the base to fit over the boss of the case and the protruding portion of the primer.

The Mark I.C. stream-line shell is made of forged steel with an

eight calibre radiused head and a parallel cavity.

The head of the shell proper is screwed internally to the 2-inch fuze-hole gauge, or alternatively, when shell have been manufactured light to weight or with defective fuze-holes, the top of the shell wall

is cut down, recessed and screwed externally and fitted with a separate screwed-on head which is screwed internally to the 2-in. fuze-

hole gauge.

The body of the shell is tapered off below the driving band to the base at an angle of 7° 30′ and a steel plate disc is screwed or riveted into a recess in the base. The driving band is similar to that of the other 18-pr. shell.

The base of the cartridge case is painted with a 1-inch white

outer ring, the remainder being yellow.

CARTRIDGE, Q.F. 18-PR., CORDITE, M.D. OR R.D.B., GAS SHELL.

The case and primer are the same as described for the shrapnel cartridge.

The charge consists of 1-lb. 6-oz. 15-drs., size 8, M.D. or R.D.B.

cordite.

The charge for India consists of 1-lb. 4-oz. of cordite, size $7\frac{3}{4}$, and is similar to that described with shrapnel.

The base of the cartridge is painted light grey for identification

purposes.

The shell is made of steel, iron or semi-steel, with a two-calibre radius head. It has a parallel cavity tapered off near the bottom and the head is screwed internally to receive a combined fuze socket and burster container; a tapered filling hole is provided below the shoulder of the shell.

The burster container is about 2.53-inches deep and has a tapered flange at the top, below which it is screwed to suit the shell. The mouth is screwed to the 2-inch fuze-hole gauge to receive the No. 106 fuze

A copper driving band similar to other 18-pr. shell is provided and a steel plate disc is screwed or riveted into the base of the shell, except in the case of Marks II and V shell, the bases of which are solid.

The shell is painted grey with a coloured band round the body denoting the type of gas with which filled.

CARTRIDGE, Q.F. 18-PR., CORDITE, M.D. OR R.D.B., SMOKK SHELL.

(Plate XXX.)

The case, primer and charge are the same as for the shrapnel shell.

The base of the cartridge is painted green for identification purposes.

The shell is made of forged steel with a two-calibre radiused head

and a parallel cavity.

The head of the shell proper is screwed internally to the 2-inch fuze-hole gauge to receive the fuze and a steel shell exploder container and is provided with a fixing screw for securing the fuze.

A steel base plate is screwed or riveted into a recess in the base and a copper driving band is fitted into an undercut groove the bottom of which is either knurled or has two waved ribs formed to

prevent the band from turning on the shell.

The smoke composition is contained in a tinned plate container which is "U" shape in section the exterior being shaped to fit the shell cavity and the interior to receive the tube of the exploder container.

The shell is painted light green for identification purposes.

CARTRIDGE, Q.F. BLANK, 18-PR., FILLED, 1-LB. BLANK, L.G.

The Mark II blank cartridge consists of a service case and percussion primer with a charge of 1-lb. Blank L.G. contained in a No. 1 class silk cloth bag having three silk braid hoops, which, together with a felt disc and lifting loop, is enclosed in a felt jacket.

The mouth of the cartridge is closed with a millboard wad, split

paper ring, and leather-board cup.

CARTRIDGE, Q.F., BLANK, 18-PR., FILLED, 8-OZ. 12-DRS. CORDITE M.D.T. OR R.D.B.T., SIZE 15/13, MARK I.

This blank cartridge consists of a service case and percussion primer, with a charge of 8-oz. 12-drs. cordite M.D.T. or R.D.B.T., size 15/13.

The charge consists of a circular bundle of cordite, tied in three places with "silk, sewing, No. 1," and having a recess at one end to take the end of the percussion primer in the base of the cartridge.

The igniter consists of two circular shalloon discs stitched together to form a circular pocket in the centre and an outer ring, the latter being stitched across to form four pockets. The pockets are filled with 6-drs. of R.F.G.² powder, 2-drs. in the centre one and 1-dr. in each of the pockets of the ring.

The igniter is placed over the end of the charge and tied to the first tie of the bundle in four places, the centre pocket being placed at the bottom of the recess in the cordite and the outer ring over the

ends of the outside sticks of cordite.

The charge is held in position in the cartridge with a millboard

disc, split paper ring and leatherboard cup.

The Mark II M.D.T. cartridge differs chiefly from the above in having no recess at the base of the charge to receive the percussion primer.

The empty cases for making up blank locally are issued 20 in a

"Box, cartridge cases, Q.F. 18-pr."

Instructions for making up blank and smokeless blank cartridges with charges issued for the purpose, as may be necessary from time to time, will be found on the lid of the box in which the empty cases are received.

CARTRIDGE, DUMMY, Q.F., 18-PR.

The Mark II dummy cartridge is for use in practising fuze setting. It consists of an empty service shell body secured in a service case in the usual manner and further secured by a bolt, one end of which is fitted into the primer hole of the cartridge and the other end screwed into the base of the shell.

The shell is fitted with a 2-inch fuze hole socket closed at the

bottom, and is filled with a mixture of dust and lead ash.

The cartridge case contains a wood block which is recessed at one end to fit over the boss in the base. Four holes are bored in the side and three in the base of the case, for ready identification of the dummy cartridge.

CARTRIDGE, DRILL, Q.F. 18-PR., MARK V.

The cartridge is made of wood shaped to represent the service shell and cartridge case. It is fitted with a brass base and metal nose, which are connected by a screwed mild steel bolt, the end screwed into the brass base of the cartridge having a recess with a rubber plug for the gun striker to impinge against. The metal nose is threaded to the 2-inch fuze hole gauge and provided with a fixing screw.

The Mark VI drill cartridge differs from the above in having a

slightly different shaped fuze hole socket.

FUZES.

Instructions Relating to the Care of No. 106, 106E, 115 and 115E Fuzes.

(1) The wire seal is broken and the safety cap of the No. 106, 106E,

115 and 115E fuzes removed only immediately prior to loading.

(2) If a No. 106, 106E, 115 and 115E fuze has become uncapped in any manner except that referred to in (1) or has the wire seal inadvertently broken, it is to be regarded as unfit for firing and is to be withdrawn from use.

(3) Fuzes withdrawn under paragraph (2) are to be examined to ascertain if the brass tape under the hammer head is present and correct; if this is so, the (safety) cap should be replaced and secured in position by a becket, and the fuze returned to the Ordnance Store for transmission to Woolwich. If examination shows that the brass tape is incorrect, or missing, the fuze may be in a dangerous condition and must be destroyed under expert supervision.

In securing the (safety) cap with the becket, difficulty may arise with fuzes, where the body is not provided with an eye through which the becket may be threaded; in such cases wooden pegs should be driven in the fixing key holes in the body and the becket fustened round these.

(4) It is essential that the becket should be fastened in such a manner as to prevent the cap coming off in transit to Woolwich. The method of fastening the fuze-cap is shown on Plate XXXVII.

Fuze, Time and Percussion, No. 80. (Typical.)

(Plate XXXI.)

The fuze is made of aluminium, brass or steel according to the pattern of the fuze and consists of the following principal parts, viz., body with ring, upper and lower composition rings, two cloth washers, cap with set screw, base plug, time and percussion arrangements.

The lower part of the body is arranged to provide a holder for the percussion arrangement, and the upper portion forms a short stem containing the time detonator pellet and its stirrup spring, the holder being either a separate fitting or a part of the body according to the design of fuze. With aluminium fuzes the shoulder or flange of the body is fitted with a ring, to the lower part of which the fuze cover is secured. The upper part of the ring is graduated from 0 to 22, each graduation being divided into 10 parts; a square notch is cut for the "Key, No. 17 or 32," for fixing purposes and a small cross to denote the safety point. The Mark XI fuze is provided with a stud in the place of the square notch and requires the No. 73 key for fixing purposes. The lower part of the ring fits over the nose of the shell and a leather washer soaked in mineral jelly is provided to make a tight joint between fuze and shell.

The fuze is screwed externally to the 2-inch gauge.

A pin is screwed into the lower time ring to form a projection, by means of which the ring is set with the "Key, No. 18." A setting mark is cut on the ring.

The upper time ring is prevented from turning by two pins, which

secure it to stem.

The cap is screwed on to the body over the upper time ring at a certain definite tension. It is secured in position by a set screw.

The base plug is screwed externally to fit the bottom of the

body.

The holder for percussion arrangement carries the needles for both the time and percussion detonator. It is bored to receive the percussion detonator pellet, ferrule, stirrup spring and spiral spring.

All the external joints are waterproofed and a brass cover is

provided.

To remove the cover from the fuze, tear off the strip securing ring, then remove the tearing-off strip, when the cap will fall off leaving the fuze exposed.

The fuze when set full should burn, at rest, for about 22-seconds. To set the fuze, turn the setting mark on the lower ring opposite

the graduation required, by means of the "Key, No. 18."

Action of fuze.—Time arrangement.—On shock of discharge, the detonator pellet sets back on to the needle, straightening the clips of the time stirrup spring, firing the detonating composition and so igniting the composition of the upper ring, which in succession lights that in the lower ring and so fires the magazine.

Percussion arrangement.—On shock of discharge, the ferrule sets back over the detonator pellet, straightening the clips of the percussion stirrup spring; the whole is then free to move forward on impact or graze and after compressing the spiral spring, the detonator strikes the needle which ignites the composition, and so fires the magazine if the time arrangement has not functioned.

The fuzes are packed one in a "Cylinder, No. 80r."

FUZE, TIME AND PERCUSSION, No. 80B.

The fuze is generally similar to the No. 80, but the lip of the flange is removed.

FUZE, TIME, No. 180.

(Plate XXXII.)

These fuzes are similar to the No. 80 fuze, but have the percussion arrangement removed, the holder being plugged with a hardwood plug. They have a large "T" painted in blue on the side.

FUZE, TIME, No. 180B.

These fuzes are similar to No. 180 fuzes, but have no lip to the flange.

FUZE, PERCUSSION No. 101E.

(Plate XXXIII.)

The fuze consists of the following principal parts:

Body, cap with needle, graze pellet, detonator, plug, creep spring, centrifugal bolt, detent, detent spring, safety shutter and adapter.

The body is screw-threaded externally at its lower end to the 2-inch fuze hole gauge, while its upper end is conical in shape and fitted with a rounded cap. Below the cap the body is bored out to receive the graze pellet and below this again a fire channel leads to the safety shutter. A second opening, of two diameters, is bored in the body parallel to the fire channel for the reception of the detent and its spring; after assembly and inspection of the empty fuze this opening is closed at the top by a brass or copper ball. Near the upper end of the opening of the larger diameter and through that of the smaller diameter, a hole is bored at right angles for the centrifugal bolt. Around the outside of the body is a knurled ring, black band or groove to denote that the fuze is not fitted with a cocked pellet, and slots are provided to receive the No. 53 key for fixing purposes. A groove is formed round the lower end of the body for the purpose of punch stabbing the fuze into the shell. The lower end of the body is bored out and screwed to receive an adapter.

The cap which is screwed into the upper end of the body, has a

steel needle screwed in from the top.

The graze pellet is hollow and is screwed internally at its lower end for the plug. Its upper end is stepped to form scatings for the centrifugal bolt and creep spring. The space between the bottom of the pellet and the top of the shutter is filled by a paper cylinder.

The plug, which is screwed into the graze pellet from the underside, has a central fire channel bored through it. It forms a support

for the detonator.

The detonator consists of a copper cup containing 1.7-grains of detonating composition; the top of the composition is covered by a brass disc and copper washer and its underside by a brass disc, the whole being held in the cup by the top edge of the latter being spun over. It fits inside the graze pellet, in which it is held by the plug.

The creep spring is interposed between the upper end of the graze

pellet and the underside of the cap.

The centrifugal bolt is fitted into an opening at the upper end of the body, the opening being closed by a screw plug. The bolt is kept in position by the stem of the detent which passes up behind it. Its inner end fits over a shoulder on the upper end of the graze pellet.

The detent consists of a body with pin connected by a ball and socket joint; the stem of the latter passes up through a hole in the top of the fuze and behind the centrifugal bolt and is kept in position by a spiral spring, which bears against the underside of the body and is held in position by a plug screwed into the body of the fuze.

The safety shutter is housed in a circular recess on top of the gaine adapter. It comprises a metal disc, shutter, detent, spring, and tin cap.

The disc is circular and is bored axially to provide a fire channel, whilst a transverse slot is cut across its upper surface to receive the shutter, detent and spring. The shutter is rectangular in section and slides freely in the slot of the disc, but normally masking the fire channel; one end is slotted and bored to receive the detent stem, the other end being plain. The detent, of ball and stem in one, rests in the disc slot with the stem entered in the shutter recess centring the C.G. of shutter to the spring side of the fuze axis. The spiral spring retains the shutter in the closed position and lies between shutter and tin cap. The tin cap has a central fire channel and fits over the disc retaining the shutter devices in the assembled position.

The shutter opens when spun at revolutions from 2,000 to 3,000 per minute.

The adapter is screwed externally at its upper end to screw into the bottom of the fuze, in which it is held by a set screw, and internally for the greater part of its length to receive the gaine, which, in turn, is held by a set screw. The upper end of the central opening is plain and enlarged to form a chamber for the reception of the safety shutter.

No preparation for action is needed.

Action.—On firing, the detent behind the centrifugal bolt sets back, compressing its spring. When the stem of the pin is clear of the fuze body, centrifugal force carries the stem over and the spring re-asserting itself jams it under the shoulder of the recess. This leaves the centrifugal bolt free and the rotation of the shell causes the bolt to move outwards and so unlocks the graze pellet. Whilst the shell is under acceleration in the bore the friction caused by the set-back of the shutter will probably prevent the latter opening. After the shell has left the bore the shutter is moved outwards In moving outby centrifugal force compressing the spring. wards it releases the detent. The detent stem being unsupported moves out of centre and engages a shoulder in the shutter and so keeps the shutter clear of the fire holes in cap and disc. During flight the graze pellet is prevented from moving forward by the creep spring, but on graze or impact it moves forward, carrying the detonator on to the needle. The flash from the detonator passes down through the fire channels to the gaine, which in turn detonates the bursting charge in the shell. The fuzes are packed one in a tin cylinder No. 101F.

GAINE No. 2.

The gaine, which forms the magazine of the Nos. 101E and 101 fuzes is of steel, screw-threaded externally at each end to fit the adapter and take the closing cap respectively. Internally it is bored from each end to form two compartments separated by a diaphragm which is pierced by a fire channel.

The upper and smaller compartment is filled with gunpowder in the form of perforated pellets, on the top of which may be placed a

solid layer of gunpowder to provide a delay action.

The lower compartment contains pressed C.E. and a 10-grain fulminate detonator. A charge of 4.5-grains of gunpowder is placed on top of the fulminate. The bottom cap closes the gaine.

When provided with delay, the gaine has a blue band and the

fuze cap is painted blue.

Action.—The flash from the fuze detonator ignites the powder in the upper compartment, and so strengthened, passes through the fire channel to ignite the powder in the detonator. The fulminate detonates the C.E.

If fitted with delay powder, the latter burns through before passing on to the detonator, so introducing a pause between graze of shell and detonation of gaine.

FUZE, PERCUSSION, D.A., No. 106E.

(Plate XXXIV.)

The Mark IV fuze consists of the following principal parts:—Body, safety cap, hammer, steel collar in halves, copper tape with weight, steel and dermatine washers, copper shearing wire, steel guide pin, detonator holder, detonator, magazine with shutter, shutter spring, bottom screwed cap, shalloon and paper discs.

The body, which is made of metal, is screw-threaded externally at its lower end to suit the 2-inch fuze-hole gauge. Its upper end, which is generally conical in shape, terminates in a cylindrical stem, which is screw-threaded to receive the cap. Slots are cut in the body to receive the No. 53 key for fixing purposes. The body is further prepared to receive a shearing wire, guide pin and a countersunk hole to take the wire securing the cap. A groove is cut round the shoulder for punch stabbing the fuze into the shell when fuzing the latter.

Internally the body is bored out in different diameters to receive

the hammer, detonator holder and magazine.

The hammer is of steel, fitted with an aluminium head. The lower end is pointed to form a needle. Just below the head a recess is bored to take a stud on one-half of the steel collar and in one side a slot is cut through which fits the shearing wire and guide pin. The hammer is placed in position from the top of the fuze body passing through a steel washer on the top of the latter. The guide pin is screwed into the body, one end entering the slot in the hammer. The shearing wire passes through the body and hammer, the ends being afterwards turned over. The function of the guide pin is to prevent the hammer turning whilst the tape is being unwound, while the shearing wire keeps the hammer clear of the detonator after the collar has become detached. Around the hammer, under the head and resting on the steel washer of the body, is a steel collar in

halves, one half of which has a pin to fit the recess in the hammer, and around this again is wound a copper tape to the outer end of which is soldered a weight. The top of the fuze is closed by a \begin{align*}\begin{align*}\begin{align*}\left\ -\ \\ \end{align*}\). The top of the fuze is closed by a \begin{align*}\begin{align*}\left\ -\ \\ \\ \end{align*}\). The top of the screws on to the projection at the top of the body against a dermatine washer, and is held in position by a steel wire which passes through an eye in the cap, the two ends being twisted; a complete turn is then taken round the cap and the loose ends inserted in the hole provided in the body and fixed therein by a lead plug pressed in.

The detonator holder is held in position by the top surface of the magazine. Its upper end is recessed to receive the detonator, which is held in position by the mouth of the holder being spun over. A cupro-nickel or brass disc is placed on top of the detonator. An opening in two diameters is bored through the centre of the holder below the detonator which is filled with loose C.E., the opening being closed by a paper disc shellacked to the bottom of the holder.

The magazine is screwed externally to suit the interior of the body and is reduced in diameter near the bottom and screwed to receive the bottom cap. The top of the magazine is recessed to receive a shutter and spring. The magazine is bored internally in two diameters to within '003-inch of the shutter recess, the smaller bore is filled with loose C.E., whilst the larger bore takes a compressed pellet of C.E. A paper disc separates the loose C.E. from the pellet.

The shutter is of metal, shaped and pivoted to admit of movement when acted centrifugally. It is interposed between detonator holder and magazine, and in the closed position is designed to prevent the detonator functioning the magazine. It is pivoted at one end by an axis pin, and is retained in the closed position by a coiled spring sufficiently strong to prevent movement until a rotation of 1,300 to 1,700 revolutions per minute is attained. A hole is bored through that portion of the shutter which is in the central position when shutter opens; this is filled with loose C.E.

A set screw is screwed into a hole in the body of the fuze and holds the magazine in position.

Preparation of fuze.—To prepare the fuze the wire is broken, and the cap unscrewed and removed at the moment of loading.

Action.—After leaving the bore the rotation of the shell causes the weight on the tape to fly outwards and the latter to become unwound from the steel collar; the halves of the steel collar in turn drop off, leaving the hammer supported only by the shearing wire.

The rotation of the shell causes the shutter to swing outwards until the hole formed in it comes into line with the central perforation in the detonator holder and magazine. On impact the hammer is driven in, breaking the shearing wire and piercing the detonator; the consequent detonation passes through the loose C.E. in the detonator holder, shutter and magazine to the C.E. pellet in the magazine, which, in turn, detonates the H.E. charge of the shell.

The Mark IVS fuze differs from the Mark IV, the head of the hammer being made of steel instead of aluminium.

These fuzes are packed one in a tin cylinder, No. 101r, with exploder.

FUZE, PERCUSSION, D.A., No. 106.

This fuze differs principally from No. 106E in not being fitted with a safety shutter.

FUZE, PERCUSSION, D.A., No. 115.

(Plate XXXVI.)

This fuze is made of metal or steel and is generally similar in design to the later marks of the 106, the following being the principal points of difference:

The body is longer and differs slightly in external contour to agree with the 6-c.r.h. shell with which it is used, the coned portion having a longer taper. The space forming the magazine is correspondingly longer and receives a larger C.E. pellet.

FUZE, PERCUSSION, D.A., No. 115E.

(Plate XXXV.)

This fuze differs from the No. 115 principally in having a safety shutter of similar design to No. 106E and in being made of metal.